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Science Education

APPRENTICED TO ARISTOTLE[1]

HANOR A. WEBB, *Chairman,*
Division of Science and Mathematics, George Peabody College for Teachers

Aristotle—the father of the scientific method—the preceptor and exemplar of science education! For a brief time let this group of apprentices consider the teachings of our master.

It may be said of none more justly than of Aristotle: "A good man never dies." His influence began in ancient Greece in the Fourth Century B. C. After his death the seed he had sown needed time to grow; his fame was at its lowest ebb for about eight centuries. In the Fifth Century A. D. his philosophy entered the Christian schools, where it was fought, and banished. Carried in the hearts of fleeing heretics, Aristotle reached Syria, and—dead a thousand years—soon led all Eastern learning.

In the rise of Islam the Muslims borrowed the Syrian translations of Aristotle's works and carried him to Bagdad. At the head of Arabian philosophy he spread his words to Spain, but was suppressed and scattered with the Moors. The Christian Church again studied, resisted, and finally accepted him. Giving him almost holy authority they grievously misused him for further centuries.

In turn Aristotle inspired Dante, kept the Reformers in line as to their logic, and lived until the Nineteenth Century, when his true contributions to science—as an Age of Science dawned—became recognized. Now in this Twentieth Century one more humble voice may be raised appropriately in his honor.

[1] Presidential address to National Association for Research in Science Teaching, Atlantic City, N. J., February 27, 1938.

Why are we, gathered here by common interest in science education, apprenticed to Aristotle?

1. Aristotle was the founder of the experimental method. Savages are not scientists, although surrounded by nature. Thinkers need not be doers, as Plato, teacher of Aristotle, proved by his logic and his life. But Aristotle learned first hand more about fish than any fisherman, more of animals than any hunter, more of plants than any gardener or woodsman.

There is report that he personally dissected more than one hundred animals, including an oyster and an elephant, and possibly a man. He was the first great thinker to rely on the evidences of all the senses rather than on processes of reasoning—to prefer experiment to argument. Eusebius called him "Nature's private secretary"; Dante nominated him "Master of those who know."

2. Aristotle was the founder of science education. In his "The Politics" he wrote: "No one can doubt that the legislator ought principally to attend to the education of youth. In cities where this is neglected, the politics are injured. . . . For example, the Lacedaemonians deserve great praise, since they pay very great attention to their children, and this in common." Here is praise for a public school, 2,300 years ago!

Aristotle taught all of his life—as the assistant of Plato, as tutor of Alexander the Great, as leader of the "Walking School" that rivals Plato's "Talking School" and Socrates' "Debating School" in our interest as to educational method. He lived in the

hearts of his pupils, too; did not Alexander, from camps and battlefields, send pressed plants of strange species to his old teacher?

Aristotle believed that every science, great or small, might be attempted with either of two kinds of proficiency as a goal; a full scientific knowledge of the subject; or an educational acquaintance with it. "Science for culture," as a slogan, has its origin in this second idea. His discussion along the same point involves as well a distinction between the science specialist and the science teacher. Aristotle, the master, was both.

3. Aristotle studied men as well as mice. There are scientists who do not understand humanity. Of the many differentiations that Aristotle made in the types of humans he classified, one concept may be offered as an example. He recognized that some men are prosaists, others poets. He explained: "Historians write of things which have happened, poets of things that might have happened. History speaks of particulars, poetry of universals. Poetry has more of philosophy, and is more deserving of attention than is history."

If Aristotle had lived after Shakespeare instead of before the bard, he might have pointed out how far apart are prosaists and poets in their interpretations. ". . . books in the running brooks, sermons in stones . . ." so runs the verse. "Why, this is an error," the prosaist would cry. "The bard meant to write, 'sermons in books, stones in the running brooks'!" But the poet would sense a truth the prosaist could never understand.

Not all of science is for the fact-gatherers—very much lies beyond the rule and record.

I saw a tree that prayed a prayer.
Its arms outstretched, uplifted bare,
  Reached heavenward as if to seek
  Surcease from winter—bitter, bleak.

I saw a tree that sang a song
As soft winds warmed it all day long
  While leaves grew green, and buds grew bright,
  And twigs reached out into the light.

I saw a tree that made a speech,
And flung its gifts beyond its reach
  And clad itself in colors gay.
  Then, bare, began again to pray.

"But trees neither pray, sing, nor make speeches," the botanists remind us—for which literal fact we may be thankful. Yet we poets understand.

4. Aristotle offered the world the first concepts of a truly efficient Higher Power. I am aware of the antiquity of the Hebrew ideas of Jehovah, with personal prejudices and tribal preferences which a later interpreter, Jesus of Galilee, tried hard to alter in the minds of men. The Romans, the Barbarians, the Greeks themselves, had systems and objects of worship. But Aristotle bowed before no image and sat before no priest.

Aristotle believed that man occupies a mid-ground between the temporal and the eternal—that he is part an animal and part a god. More than any other creature, man takes the guidance of his life in his own hand. Through ethics, politics, and aesthetics he learns to live with his neighbors; through science and philosophy he rises to divine levels, and plays the part of an immortal. Man's noblest power, states Aristotle, is that of contemplation—but he hastens to add his observation that this godlike energy is possible for man only at rare intervals and for limited periods.

Said Aristotle: "The more I find myself by myself and alone, the more I become a lover of what can not be proved." He was not merely intrigued by mysticism, as one with a shallow mind is apt to be. The uncertainty of "that which can not be proved" was quite distinct from the ingenious evasiveness of the Oracle. The priestess, as you may recall, would speak in measured tones to the soldier: "Thou—shalt—go— thou— shalt— return —never —in—battle — shalt — thou — perish." If the priestess had paused either *before* or *after* the word "never" she would have committed the oracle to a specific prophesy. ". . . never in battle shalt thou perish

. . ." is certainly a different answer from ". . . thou shalt return never. . . ."

Aristotle was not impressed with omnipotence. "Of a certain power even God is deprived—that of making what is past never to have been" he wrote. He probably placed other limits on Omnipotence, and it is fortunate that he did not live in the days of the Inquisition.

If Aristotle possibly more than any other man that ever lived has influenced the careful reasoning of mankind (as distinct from his emotional thinking), is there not some way to use his philosophy as a pivot for world knowledge? Could not science, as he originated it, develop a common understanding among men?

Politics has not brought peace to this planet. The struggle between a few conflicting political systems spreads widely and dangerously.

Theology has not taught men how to live as neighbors in this roomy world. The history of religious warfare is as long and bloody as that of civil strife. Neither Buddha the Sage, nor Mohammed the Prophet, nor Jesus the Prince of Peace, can control his nominal followers.

Science has not been requested by those in power to serve the cause of peace; the technical needs of war have been far too great! Yet here is the mighty figure of a man, Aristotle, who knew nature first hand and saw man as part of nature; who studied man and found God as part of man; who contemplated God and found God back in nature again.

Certainly I do not offer science as the formula to save man's soul, for science is a way of life, not a hope of immortality. But it may be that science must save civilization. Its principles are now prostituted in the service of death; is there not some sanctuary into which this harried philosophy may retreat and be shriven of hate and horror? Throughout the world, scientists are more earnestly serving dictators than the cause of truth; they fulfill the demands of demagogues rather than the needs of humanity.

Voices have often been raised to urge that since scientific truth pervades the universe, scientific thought and service should know no national boundaries. Is it becoming vain to hope that scientists of many lands may become brothers-in-Truth? Is there not some place to establish another Peripatetic School of Science, with Aristotle's statue in its garden, from which science as a power for peace may walk all over the world?

REFLECTIONS ON SCIENCE TEACHING IN THE U. S. A.*

J. A. LAUWERYS

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Now for some criticisms which I hope will be taken as those of a friend and admirer. Anyone who, like myself, has visited a large number of schools in this country, and has had the opportunity and pleasure of conversing and arguing with many teachers, will have been struck by the extraordinarily high ideals and by the cheerful optimism which prevails. It is, I think, true to say that teachers of science over here are keenly aware of their social responsibilities, very desirous that their work shall meet the needs of their pupils, anxious to illustrate in their teaching the relationship between scientific work and the life of the people. But it is sad to note the enormous distance between the ideals thus expressed and the practices of the classroom. In this respect there would appear to be a gradual deterioration from the kindergarten to the University. In the Senior High School in particular the work done seems usually about as abstract and as academic

* *Concluded from March issue.*

as in England. It is so surprising, after talking for a while to a teacher imbued with the social philosophy of John Dewey, to hear that same man in the classroom teaching like a pedant imbued with Aristotelianism. You know the sort of thing I mean—"Today we shall determine the density of solid bodies of irregular shape" or "Today we shall study the principal properties of the oxides of chlorine."

What is the cause of this, and what is to be done about it?

Next, I have often felt distress at the comparatively low level of actual performance and efficiency in the classroom. On only a few occasions have I met a real problem approach. Scientific work has its beginnings when men tackle tasks that are felt to be socially important. Thus arise a number of problems which men of genius consider and analyze. The results of their researches may then find further applications, leading to fresh enquiries and to new applications—spiralling on towards ever more profound and far reaching understandings and generalizations. Characteristic of such scientific activity is heurism—the spirit of enquiry, seeking continually to uncover — and scepticism — the spirit of doubt, of lack of certainty, of questioning of authority, the dislike of being told, the refusal to accept any authority but that of experimental fact.

Now, if we want to make our pupils appreciate and understand the processes of thought characteristics of scientific activity they must be brought into sympathetic contact with it. This means that the science lesson must itself be scientific—the pupils must be brought up against problems the solution of which they know to be important. And they must be encouraged to think scientifically in their attempts to solve them.

This kind of real problem approach I have but seldom found. True, I would have found it just as seldom in England—but my hopes would not have been so high over there.

Then as regards the teachers' technique. Here I really am quite disturbed—there is a lack of thoroughness and of craftsmanship which distresses me. For progressive teaching necessitates a much higher level of performance than formalized teaching which follows a set pattern sanctioned by custom. I am quite ready to admit that the pupils I have observed have been interested and entertained — though not always. But merely to arouse interest is not enough—it must be interest for something, a motivation to accomplish something. To arouse interest is merely to sensitize the mind—there still remains the problem of what is to be done with the potential activity—the pupils must not be allowed to leave the room uninfluenced by their hour's entertainment.

But it would be well to indicate more precisely the kind of thing I have in mind, *e.g.*:

A. Questioning seems to have degenerated into a guessing competition. Yet Socrates, as you will remember, used the mistakes of his disciples in order to instruct them. His unfortunate end need not deter us from following his excellent example.

B. Few of the lessons I have observed concluded with a summary of work done—the sort of summary which might serve to articulate the material learned and to exhibit its relation to other work.

C. Few lessons have ended with the thorough questioning and evaluation carried out to see whether the students had really learned anything at all.

D. Blackboard writing is a lost art—blackboards have become unornamental ornaments. I cannot remember seeing a teacher develop his lesson on it—so to say exhibiting the skeletal structure of his lesson on it. Seldom did I see teachers drawing rough diagrams on it, or making much real use of it at all.

I should repeat, taken by themselves not one of these criticisms is at all serious. But it seems certain that our efficacy in the classroom would be increased if more attention were paid to such points of craftsmanship in teaching. This in no way implies advocating a return to outmoded methods. But it is just possible that our reaction against pedantry may have led us to under-

estimate the value of thoroughness of teaching—we may, perhaps, have emptied out the baby together with soiled bath water!

None of the questions dealt with so far involved really fundamental problems. Yet if teachers of science are to make the contribution they could make to the development of a Democracy in the United States, fundamental issues will have to be faced. Profound and far-reaching changes in curriculum and methods will be necessary.

The education of children is not merely, as many people in Great Britain seem to think, a process by which a tradition is transmitted and the *status quo* maintained. It is also an agency by which the community transforms its modes of living, of thinking and of feeling. As John Dewey puts it: "Education is the fundamental method of social progress and reform."

Now the kind of world in which I want to live and in which I think my children would like to live will be more easily built up if many people know certain facts, think in a certain way, and hold certain social ideals.

A. Information. It would be very helpful if many people knew certain facts. For instance, it is essential that everyone should know that the technical means at our disposal now make it possible to feed, clothe and shelter every inhabitant of the earth and that it is not lack of material resources that prevents us from doing this. It would be well if everybody knew that the advance of medical science has made it possible to do away within a generation with tuberculosis and venereal diseases, and that it is not lack of knowledge which prevents this accomplishment. And so on. It is unnecessary to multiply examples—there are so many facts of this kind which ought to be more widely known than they are. And, besides these, there are so many facts which, if known to adolescents, would make it simpler for them to live fuller and happier lives and easier to develop well-integrated personalities, capable of effective action.

B. Clear and Rational Thinking. The kind of society we desire can only be built up if certain ways of thinking and certain attitudes of mind become more common than they are. More people must learn to form judgments on facts rather than on prejudice, more people must learn to distinguish between fact and fancy, opinion and knowledge, law and hypothesis. In a word, more people must learn to think clearly and rationally—scientifically, if you like. We must strive to extend the boundaries of the rational, of the conscious, of the clear.

Presumably, this means that we should pay far more attention than we do to the teaching of scientific method—and here we tread on dangerous ground. For the whole issue has been befogged and muddled by the battles that have centered on the problem of transfer of training, formal training—call it what you will. Now, most people feel that the belief in the possibility of such transfer has long ago been shown to be false. I am well aware that objective researches have shown that it is impossible to train people to be accurate, observant, etc., merely by making them weigh or measure accurately or by making them observe, say, microscope slides. Yet this cannot represent accurately the whole position. For if things were as bad as this education itself would become useless and meaningless—since the classroom situations are so specific that they will never recur.

In England most teachers are not at all concerned with this problem—for, on the whole, they continue to have implicit faith. Nor do American teachers seem to be concerned—for they, on the other hand, just feel that they cannot do anything at all to train their pupils to think clearly and well.

Yet the truth lies between these two extremes. Our pupils can be trained to think scientifically in everyday affairs—but only if we pay particular attention to the ways in which generalization of the specific training we give can be secured. Here, then, is

another great task to be faced: how are we to teach our pupils to think correctly and articulately?

C. Ideals. And lastly the kind of world we want can be built up only if and when the great majority of our citizens have developed ideals of social conducts, and have found ways of expressing collectively those ideals. I want people to be sensitized to social injustice. I want them to feel hurt when they hear of famine or disease or massacre or war or injustice even in cities and countries other than those in which they live. And I want them not merely to think and to feel about these things, but also to act.

For it must be realized that merely to know is not enough. Even men as clear-thinking as H. G. Wells believe that when everyone knows the facts of the situation, reforms will be made. And these people are in good company—it was Plato, I believe, that first enunciated the aphorism that to know the Good was to love the Good and to do the Good. But I fear that the present state of the world is a disproof of the Platonic thesis.

It may be thought that scientific studies have but little contribution to make in the building up of ideals of conduct. But to suggest this is to take a narrow view of scientific activity. For here we have a branch of human knowledge and action motivated by the highest social and ethical ideals, and which can function well only when its devotees act in a selfless and disinterested manner. Certainly the study of science alone will not suffice, but the lives of the Heroes of Science will illustrate the fact that here is a discipline which can make to our society a contribution of unique ethical worth. For "the greatest contribution of the pioneers of science to the world's cultural wealth is not the scientific method but the scientific life."

I am anxious not to be misunderstood. I do not for a moment suppose that the information, the attitudes of mind, the ideals I have mentioned can be acquired or developed merely by the study of science. Each of the major fields of human endeavor and activity has contributions to make. Each of them provides opportunities for the encouragement of clear thinking, each can be used to encourage the growth of high ideals. A curriculum that covered nothing but scientific studies would be as unbalanced as a one-food diet—in one sense, the problem of the curriculum-builder resembles that of the dietician. How is he so to combine the material at his disposal that those he plans for will grow healthily?

Since I have been in the United States, I have begun to think that American teachers of science are, on the whole, more sensitive than their English colleagues to the needs of today. I hope that they will strive to discover ways by which our educational system may do more than it has to transform our society. For, to me, this country seems far more hopeful than any in Europe. Privilege is here less firmly entrenched than with us—the dead hand of tradition is less powerful. The pioneer spirit is not yet altogether dead! People are still prepared to face even fundamental changes in their ways of living and of thinking. Above all there is far more concern with the idea of democracy, far more realization of the fact that it is not merely a form of government but a way of living together and that it is an ideal not yet completely accomplished, and which will require much effort and many changes. Lastly, a much clearer realization of the fact that the school itself is the chief agency of peaceful change, and that an educator has it in his power to change the life of tomorrow, since he has in his care the citizens of tomorrow.

A STUDY OF THE STATUS OF THE CRITIC TEACHER OF SCIENCE IN THE COOPERATING PUBLIC SECONDARY SCHOOLS OF THE EASTERN UNITED STATES*

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The value of the critic teacher in the present day teacher training institutions is widely recognized. Whitney stated, "One can almost generalize by saying, that, as is the critic, so will be the first school of the new graduate."[1] Thus in the preparation of the natural science teacher for our secondary schools the critic or training teacher plays a most important rôle. It is the purpose of this study to survey the status and activities of these teachers in the cooperating public secondary schools in an attempt to more clearly define their position in the total teacher training picture.

SETTING OF THE PROBLEM

The beginning of the use of critic teachers occurred early in the history of our schools. Probably the first real use of this type of supervisor began in the Oswego practice school of about 1861. However, the spread of the practice has been very slow. It has been confined to the normal schools and professional teachers colleges very largely up until the last decade. There is a great lack of information on the subject of the critic teacher at the present time. Although some studies have been made, very little has been published concerning his status.

Mead made the following statement on the subject, "Perhaps the first man in the United States to labor consistently and persistently for an improved status of the supervising teachers is William C. Bagley, yet he has not made a detailed analysis of the functions of this worker."[2] The scarcity of information is well summed up by the remarks of Bowden, "The writer has been unable to find any reports of a thorough job-analysis of the critic teacher's duties. Only small beginnings have been made in working out a scheme."[3]

There is an obvious need for material in consequence of this lack of studies on the critic teacher. It is to meet, in part, that need that this survey was undertaken.

Since the writer is at present acting as a critic teacher in secondary science in a cooperating public school, he feels a real interest in contributing some thing of value toward the recognition of the critic teacher. It has been his experience that one of the chief difficulties of the critic teacher is a lack of information as to his status. He is generally willing to accept responsibilities necessary in this influential work, but he feels quite at a loss many times as to just what direction he should take as a good professional worker. This study was undertaken in the hope that it might clear up many of the questions in the mind of the writer as well as be of value to others in the position of critic teacher.

THE DELIMITATION OF THE PROBLEM

The writer surveyed the problem from four definite standpoints: (1) the nature of cooperating public secondary schools, (2) the types of supervision employed by the

* A summary of a thesis represented to faculty of the graduate school of Cornell University for the degree of Master of Science in Education, August 1937.

[1] Whitney, F. S. *The Equipment of State Normal School and Critic Teachers.* Educational Administration and Supervision. Vol. 8, 1922. p. 479.

[2] Mead, A. R. *Supervised Student Teaching.* Richmond, Atlanta, etc., Johnson Publishing Co., 1930. p. 581.

[3] Bowden, A. O. *The Training of Critic Teachers in the United States.* Journal of Educational Research. Vol. XV, 1927. p. 124.

various training institutions, (3) the selection, recognition and responsibilities of the critic teachers, (4) the plans for practice teaching as conducted in the cooperating secondary schools. All of these phases in the study were centered upon the critic teacher and his position in the total picture of teacher training.

Following this survey, the writer summarized the data gathered and stated certain conclusions that may be of value in actual teacher training situations. He also indicated possible avenues for future study. By so doing he attempted to aid in establishing the critic in his proper place in training institutions using cooperating public secondary schools.

The study did not include private high schools or preparatory schools. It did not survey university high schools or schools conducted in conjunction with the training program of teacher colleges or other institutions. In analyzing the plan of the training school, the cooperating school, etc., the purpose was not to study the institutions themselves or their plan of training. It was rather to bring the functions of the critic teacher into a clearer focus.

METHODS OF STUDY AND PRESENTATION OF FINDINGS

Four general methods were used in approaching the problem: (1) A study of the practice teaching facilities listed in the catalogues of thirty-nine institutions of higher learning in the eastern part of the United States; (2) The preparation of a series of check lists covering the topics listed under the "Delimitation of the Problem." The lists were prepared by a critic teacher in conjunction with a university supervisor. They were sent to each of the training schools whose catalogues had been studied. These check lists were filled out by the university supervisors and their critic teachers. Approximately sixty per cent of them were returned to the writer for analysis. (3) Personal visits and conferences with the supervisors and critics in various institutions. (4) A search for earlier studies of a similar nature.

SUMMARY OF FINDINGS

A. The Nature of the Cooperating Public Secondary School.
   1. The cooperating secondary schools aiding in this study varied in student population from 145 to 2800. The median was 1500.
   2. Several training institutions used more than one cooperating school.
   3. The training schools used from twenty to one hundred per cent of the regular science teachers in their cooperating schools for the critic work. The greatest number used all available teachers. The smaller percentages of teachers assigned to work as critics occur in the larger cooperating schools.

B. The Supervision of the Training Institution.
   1. The practice teaching was supervised mainly by the critic teacher, the teacher of educational courses from the training school, the principal of the cooperating school and the head of the science department in the cooperating school.
   2. Flowers stated, "Responsibility for the supervision of the student teacher must center in the training teacher."[4]
   3. The most common practice was for the university supervisor to visit the practice teacher two or three times during one term. A few universities had their supervisors visit each week.
   4. The university supervisors usually visited the practice teacher for one class period. Some stayed in the cooperating school for half a day.

[4] Flowers, J. G. *Principles and Practices in the Conduct of Student Teaching.* (A Syllabus prepared by J. G. Flowers, New Jersey State Teachers College, Upper Montclair, N. J. p. 8.

5. Conferences were most frequently held with the critic when the university supervisor visited the cooperating school. He often met with the practice teacher alone and sometimes with the critic and cooperating school principal together.
6. In almost all cases practice teaching was a definite university course. Credit for the course varied from two semester hours to three hours, the latter being most common.
7. There was close correlation between the professional emphasis of the training school and the practices in the cooperating school in most cases. Some indicated the gaining of this correlation to be a serious problem.
8. The chief methods of correlating the professional emphasis of the training school and the practices in the cooperating school were, in order of their frequency of occurrence, as follows:
   a. Conferences between university and cooperating school officials.
   b. Visits to the cooperating school by university officials.
   c. Printed bulletins.
   d. Weekly mimeographed instructions.

C. The Selection, Recognition and Responsibilities of the Critic Teacher.

1. The chief bases used in selecting critic teachers, in order of frequency of use, were:
   a. Teaching success.
   b. Scholarship.
   c. Personality.
   d. Years of experience.
   e. Science preparation.
2. Baugher had this to say, "They (the supervising teachers) should have at least a master's degree and three years of teaching experience; and should have taken some special training in critic teaching during their graduate work at any one of the better accredited universities."[5]
3. Armentrout stated, "There is a real need of a distinctly professional course for preparing supervisors of student teaching. If possible, it should constitute a year of graduate work leading to a master's degree."[6]
4. The critics were chosen most often by
   a. The university alone.
   b. The university and the principal of the cooperating school.
   c. The local board of education and the superintendent.
   d. The principal and local superintendent.
5. Recognition for the critic was granted by the training institutions by
   a. Salary, varying from $25 to $50 per student per term, in 50 per cent of the cases.
   b. Free tuition for summer and extension courses in 34 per cent of the cases.
6. Little, if any, adjustment in teaching load of critic teacher was made to compensate for added supervisory work. Strebel expressed the problem well when he pointed out that,

   > Supervision of student teaching is a major professional responsibility, fully as important as teaching or administration.

[5] Baugher, J. I. *Organization and Administration of Practice Teaching in Privately Endowed Colleges of Liberal Arts.* Bureau of Publications, Teacher's College, Columbia University, 1931. p. 92.

[6] Armentrout, W. D. *The Conduct of the Student Teaching in State Teachers Colleges.* Greely, Col., Colorado State Teacher's College Education Series No. 2, 1928. p. 177.

Too often, however, . . . those engaged in supervision are required to assume these duties in addition to an already full load. Under such circumstances one may raise the question as to whether supervision is not thought of as having only secondary importance.[7]

7. Half of the training schools left the critic teacher free to select the activities for the student teachers. Very few training schools chose many of their student's activities.
8. The critic teacher was required to set aside very little time for conferences by most training institutions. However, he was expected to exercise reasonable judgment in the matter.
9. The majority of training institutions assign but one student teacher to each critic.

D. The Plan for Practice Teaching as Conducted in Cooperating Secondary Schools.

1. The training schools were evenly divided as to using local or out-of-town schools for student teaching.
2. Practice was again evenly divided as to whether or not student teachers became members of the faculty of their cooperating school.
3. Very few student teachers received salary for their practice work.
4. In most cases a definite period in the student's college program was set aside for practice teaching.
5. Strebel stated, "The student teacher should be inducted into responsible teaching by means of a progressive series of increasingly difficult and increasingly complex activities."[8] The survey showed that almost all training institutions had their student teachers follow a gradual induction plan. Several of the lists of procedures reported are as follows:

(a) 1. Orientation to school and students
2. Lesson planning and review
3. Supervising study
4. Full period of teaching
5. Individual case study

(b) 1. General orientation to the school and students
2. Study of pupil personnel
3. Assuming responsibility for clerical and paper work
4. Assuming responsibility for teaching short periods
5. Full responsibility for instruction

(c) 1. Obesrvation for 10–20 periods
2. Practice teaching
3. Observation for 1–5 periods
4. Regular teaching

(d) 1. Observation for 6 weeks
2. Remedial teaching, 6 weeks
3. Assisting critic teacher, 1 week
4. Full charge of class, 12 weeks

(e) 1. Observation for two full days
2. Assist one more day
3. Begin to teach two subjects
4. Two days later teach full four or more classes

6. Student teachers could participate in many activities, other than science teaching, in practically all cooperating schools. The most frequent of these were: assembly, home room, clubs, make up, discipline, and case studies.
7. The consensus of opinion held that the conference played a large part in the development of the student teacher. These varied greatly in their scope, being of great value in the personal contacts they brought, either in a group or in individual conference. Flowers summed up the matter by saying,

[7] Strebel, R. F. *The Nature of the Supervision of Student Teaching in Universities Using Cooperating Public Schools.* New York City, Teacher's College, Columbia University. Contributions to Education No. 655, 1935. p. 13.

[8] Anderson, C. J. Barr, A. S., and Bush, M. G. *Visiting the Teacher at Work.* New York, London, D. Appleton & Co., 1925.

"The conferences between the student teacher and those who are responsible for this training provide one of the most valuable experiences the student has during his entire period of training."[9]

8. Student teachers were rated mainly at the close of their period of training. Some were rated at each visit of the university supervisor, and others twice during the term.
9. The practice teacher was very widely encouraged to engage in self evaluation. Anderson, Barr and Bush stated, "Self analysis by the teacher is of vastly more value to her as a means of growth than the acknowledgment of any number of shortcomings, once they have been pointed out to her."[10]
10. In most cases the student teacher was rated jointly by the critic teacher and the university supervisor.
11. When the student teacher was encouraged to rate himself it took the form of an informal exercise to aid in his growth.

CONCLUSIONS

The summaries bring out the status of the critic teacher in our cooperating public secondary schools. At the present time the critic is usually a regular science teacher who has been selected by the training institution for work in a supervisory capacity with the student teachers. The critic is very seldom prepared for this work by any supervisory training. Most training schools grant the critic some form of recognition, either by a small salary or by free tuition. In addition the critic teacher is expected to determine very largely the activities in which the student teacher is to engage and to give him adequate supervision and assistance. Finally, very few critics have any adjustment in their teaching load to compenstate them for the added amount of time that they must set aside for the supervisory work.

Several problems of vital importance which will warrant future studies are suggested by these conclusions:

(1) A survey and analysis of practices in training schools in regard to the preparation of critic teachers. What is being done to train definitely these supervisors for their work? What qualifications should they meet in order to be selected as a critic teacher?

(2) An investigation of the methods used in correlating the supervisory work of the critic teacher and that of the university supervisor. What general principles can be drawn up to aid in gaining this correlation?

(3) A study of the ways in which the training school grants recognition to the critic teacher in order to standardize practices. Is recognition necessary? Is any method to be preferred?

(4) A survey of the practices in making adjustments in the teaching load of the critic teachers. How many this adjustment best be made in the case of public cooperating schools? Must the training school bear the added expense or will the cooperating schools share in this?

[9] *Op. cit.*, p. 13.
[10] *Op. cit.*, p. 18.

STUDENT REACTIONS TO A PROGRAM OF SEX INSTRUCTION

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"I don't think children of high school age are old enough to be given sex instruction. It will only encourage a stimulation of the imagination that may lead to experimentation." This statement was made by a mother in a discussion of adolescent problems.

Another apparently well-informed individual responded to this mother's statement with, "We have pretty good evidence that a large number of boys and girls are having sex experiences in spite of the fact that they have never received adequate sex instruction in the home or at school. Surely such instruction could not make the situation any worse."

These two statements are typical of the differences of opinion that exist among adults with respect to the problem of sex instruction in the secondary school. Science teachers in the secondary school recognize the need of boys and girls for some instruction in sex. They are also aware of the lack of such instruction in the home where a discussion of a problem so closely associated with the emotional life of the individual should take place. Some teachers have tried to make provision for this instruction in their respective classes or in units that may in some way be related to such instruction. Other science teachers have assumed that this understanding might be obtained incidentally through the study of the reproductive process in certain plants and animals with no direct consideration of man.

This article is a report of students' reactions to a plan that was carried out to provide sex instruction for students in the science-social studies program of the Secondary School of Colorado State College of Education.

The program of learning in science and social studies in this secondary school is planned so that students are encouraged to direct a part of their learning through problems of personal adjustment. It has been found that both these areas have a contribution in the development of understanding in these personal problems. This kind of unified learning necessitates a flexible program so that students may obtain information from both the science and social studies areas. The flexibility of this program extends into the administration of learning activities so that the student has an opportunity to work with the teacher best qualified to guide his learning.

THE METHODS OF INSTRUCTION

Two general methods of presenting sex instruction were followed during the school year 1936–1937. One approach was made by a group of students working on problems of inheritance and human reproduction. The second approach was made by a group of students through an informal discussion of the problems involved in the sex relations of boys and girls.

The problems related to inheritance and human reproduction developed from a consideration of various personal-adjustment problems of individuals. Fifty-two ninth- and tenth-grade boys and girls worked for one twelve-week period on these problems. These 21 boys and 31 girls were on the bases of chronological age, mental age and socio-economic status, considered to be a typical group of third- and fourth-year secondary school students.

The students, with the assistance of the science instructors, set up their problems and planned the units that would guide them in their learning. They used a variety of learning activities in getting the information needed. The science library was found to be inadequate as a source of information for their problems. Very little

information was found in the conventional high school biology texts. It was necessary to locate and bring into the classroom many other types of reading materials. Charts and diagrams on the reproductive cycle of man were found to be quite useful. Microscope slides of reproductive tissues were also used by the students. Some lantern slides, as well as motion pictures, were used. Students were encouraged to contact doctors, instructors on the campus, the school nurse, and the school physician for the information needed.

Students were brought together as frequently as desirable for general or small-group discussion of various aspects of the problems. These groups were as frequently mixed as segregated, boys and girls both participating in the same group. In the discussions many questions concerning social diseases, petting, and masturbation arose. Students were encouraged to bring in individuals competent to discuss these questions.

The second method of presenting sex instruction was carried out by a group of twelfth-grade students. At the beginning of the spring quarter all students in the sixth year were brought together for a discussion of problems in science and social studies that they might be interested in working upon during their final quarter in the secondary school. Sex relations and marriage problems were two that received frequent mention during the discussion. Since these were only two of many other problems that this group wanted to consider, it was decided that only one week could be spent on a discussion of each of these problems. Out of a class of 51 sixth-year students (28 boys and 23 girls) 37 chose to work upon the problem of sex relations. On the bases of chronological age, mental age and socio-economic status these 16 girls and 21 boys were considered to be a representative group of sixth-year secondary school students.

The majority of this group had had very little or no opportunity for sex instruction or a discussion of sex problems in their secondary school education. For this reason it was necessary for the science instructor to develop the fundamental vocabulary and functional concepts with the students before it was possible to have any group discussion of the questions. Two days were spent in the explanation of charts and diagrams showing the reproductive systems of male and female. This left three days of the one week allotted this problem for a discussion of students' questions.

The students were encouraged on every occasion to ask any questions concerning the functions of various structures involved in reproduction that were not clear to them. This eventually led to many questions not directly related to the actual process of reproduction but having to do with sexual relationships and sexual irregularities. Many students asked questions in class, whereas some wrote out their questions and handed them in for discussion the next day. A few of the questions asked were:

1. How can a girl or boy resist the sexual desires of another?
2. How does petting affect one's emotions?
3. Is sexual intercourse necessary for a happy marriage?
4. Should young boys and girls indulge in sexual intercourse?
5. Is there a certain period during the month when it is safe to have sexual intercourse?
6. Can a man be sterilized so that he can get the same satisfaction from sexual intercourse?
7. What harm is done if sexual intercourse is carried out during pregnancy?
8. Why should birth control be practiced?
9. What is meant by being oversexed?
10. Why is it that many girls won't go with you again if you don't "neck" them?

These are by no means all of the questions that were asked, but it gives some indication of the type of question in which these boys and girls were interested. The instructor did not feel competent to discuss some of the questions. Rather than avoiding those questions he sought authoritative advice before taking them up with the students.

STUDENTS' REACTIONS AS THE METHOD OF EVALUATING THE PROGRAM

Just as the students are given the responsibility for helping set up their problems in science and social studies they are also given the responsibility for helping evaluate any completed unit of work. In their learning, it was brought out that the ultimate value of such a program would depend upon the extent to which it aided them in living successfully with individuals of the opposite sex. It was realized that it would be impossible for any of them to give an evaluation of the program in terms of future value, but each of them could state his reactions to the program based upon his immediate needs.

The students in each of the two groups, with the assistance of the instructor directing the group activity, formulated questions that they could use as bases for their reactions to the program. Because of the differences between the two groups of students, the questions formulated by each group were not the same. The six most significant questions formulated by the ninth and tenth-grade students are listed in Table I. An analysis of the reactions of these 52 students is also presented in Table I. This table shows the different kinds of reactions made by students and the number making each kind of reaction.

The seven questions formulated by the twelfth-grade students as bases for their reactions to the program are listed in Table II. Table II also includes an analysis of their reactions. In most cases the questions were answered by "yes" or "no" followed by reasons for answering as they did. Representative reasons of students for each kind of response are listed in the table.

No attempt is being made in this report to compare the reactions of the two groups. Tables I and II are prepared to present a composite of the different kinds of student reactions to the program of sex instruction.

TABLE I

AN ANALYSIS OF THE REACTIONS OF FIFTY-TWO NINTH- AND TENTH-GRADE STUDENTS TO A PROGRAM OF SEX INSTRUCTION

Reactions Made by Students	*Number Responding*
1. Why shouldn't boys and girls study human reproduction?	
a. Know of no reason	30
b. Make conscious of process—want to try it out	4
c. It is too difficult	3
d. May use information jokingly	1
e. Parents may object	2
2. Why is there a need for such information?	
a. Can't find it elsewhere	2
b. It is necessary in choosing a mate	5
c. Realize that reproduction is natural	9
d. Eliminates fooling with sex	13
e. Corrects many wrong ideas	8
f. Clears up mysteries	8
g. Shows danger of venereal diseases	2
3. What misconceptions were changed?	
a. About masturbation	10
b. False advertisement	1
c. Sexual intercourse	13
d. Birth marks	3
e. Child birth	5
f. Sexual desires	4
g. Venereal diseases	6
h. Sex and reproduction	10
4. What were my parents' reactions?	
a. Favorable	34
b. Unfavorable	2
5. What suggested changes in class procedure?	
a. No suggestions	16
b. Needed more personal conferences	7
c. More group participation	3
d. Student participation was good considering the problem	11
e. More adult participation	21
f. Discussion in separate groups	14
g. Discussion in smaller groups	5
h. Discussion with parents, supervisors, friends (alone)	4
6. When should such instruction be given?	
a. Not later than the fourth year	8
b. In the junior high school	16
c. When the students see a need for it	16
d. Not until the last year of high school	4

TABLE II

An Analysis of the Reactions of Thirty-Seven Twelfth-Grade Students to a Program of Sex Instruction

Reactions Made by Students	*Number Responding*
1. Should there have been separate groups?	
a. Yes, because:	3
(1) Feel free to ask personal questions.	
b. No, because:	34
(1) Get both girls' and boys' points of view.	
(2) Get better understanding.	
(3) Problems pertained to relations of both.	
(4) Sex is nothing immoral.	
(5) Girls and boys have similar problems.	
2. When should such work be given?	
a. Whenever the student wants it	3
(1) Whenever the question arises.	
(2) It should be given each year so that those who are interested can take it.	
b. The last year in high school, because:	6
(1) It would be better understood.	
(2) Younger students would misuse it.	
c. Earlier than the last year	16
(1) In the sophomore year of high school.	
(2) The earlier he gets this the better.	
(3) Should be given in the junior high school.	
3. Was enough time spent on the problem?	
a. No, because:	37
(1) Need at least three weeks.	
(2) Need more time to understand fully.	
(3) Should last at least a quarter.	
4. Should there have been more class participation?	
a. No, because:	2
(1) Students did well concerning the problem.	
b. Yes, because:	
(1) Needed more time to develop.	
(2) It was just beginning to develop.	
5. Should other individuals have been brought in?	
a. No, because:	3
(1) Wouldn't feel so free to talk.	
b. Yes, because:	29
(1) Both men and women.	
(2) A woman should have given her point of view.	
(3) A doctor or a nurse would have helped.	

TABLE II.—(*Continued*)

Reactions Made by Students	*Number Responding*
6. Was the vocabulary understood?	
a. No, because:	6
(1) Scientific terms were hard to understand.	
(2) The diagrams and pictures helped.	
b. Yes, because:	10
(1) Vague at first but understood later.	
(2) More time should have been taken to explain the terms used.	
7. Were my personal problems discussed?	
a. No, because:	2
(1) Too much time to explain the others.	
(2) Too embarrassed to ask questions.	
b. Yes, because:	15
(1) Many questions were cleared up.	
(2) Best education I have got out of high school.	
(3) Learned more than any other course.	
(4) Many wrong ideas were changed.	
8. What were my parents' reactions?	
a. Unfavorable	2
(1) Too vulgar to be discussed in mixed groups.	
(2) Opposed at first but changed later.	
b. Favorable	35
(1) Thought every young person should know about sex.	
(2) My parents would have been glad to have had such a course.	

Summary

The following generalizations are based upon the analysis of student reactions to this program of sex instruction:

1. The majority of these adolescent boys and girls recognized a need for information concerning sex relations.
2. Most of these boys and girls felt that sex instruction should be given early in the junior high school, although this should depend upon individual interest and needs.
3. Misconceptions concerning sex were common among many of these students.
4. Most of the parents were in favor of sex instruction in the secondary school.
5. The students favored the discussion of sex questions in mixed groups.
6. None of the sixth-year students felt that one week was long enough for the discussion of such a problem.

7. Most of the individuals recognized the value of student and adult participation in the discussion of such problems.

TEACHERS' RECOMMENDATIONS

The following recommendations relating to sex education were formulated by the teachers who took part in the work described in this report:

1. Problems related to sexual adjustments of the adolescent boy and girl should be recognized as a vital part of the curriculum of the secondary school.
2. Teachers should not assume that a study of the reproductive process of lower organisms supplies the information necessary for these boys and girls to make an intelligent adjustment to their developing reproductive potentialities.
3. A program of sex education is not adequately realized by limiting the learning to a discussion of the facts involved in human reproduction, but must make provision for consideration of the social implications.
4. There should be no set time or stereotyped unit of work on sex instruction in the science-social studies program that all students would take, but students should be given the opportunity to help in the development of an activity that is suitable to their needs and interests at a time when that need is present.
5. There should be provided more usable materials related to the problem of human reproduction and suitable for use at the high school level.
6. The possibilities for the development of a program of sex education is not limited to the activities of any one area of the secondary school, but is present in every situation where boys and girls are brought together.
7. Adults who take the responsibility for helping students obtain the information necessary to make satisfactory sexual adjustments should be emotionally stable and themselves sexually well adjusted.
8. Teacher training institutions should make provision for prospective teachers to obtain training that will prepare teachers to guide students in making suitable adjustments to sex.

EXPERIENCES IN PHYSICS

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The large increase in enrollment in the secondary schools, within the last few years, has brought into school systems an increasing number of students who are in no way interested in obtaining an education beyond that offered by the high school. To meet the need of the latter group, courses, especially adapted, in increasing numbers have been offered. More extensive shop program for boys, and more elaborate courses in home-making and other practical arts for girls are now included in many curriculums. Before these courses were offered, students dropped out of school or failed in their work because they found the traditional courses too difficult.

About 1930–31, it was discovered at Thomas Jefferson High School, Elizabeth, New Jersey, that students who were doing outstanding work in shop courses had studied physics. Shortly afterwards, when curriculums were undergoing revision, as a result of this discovery, it was decided to require all students following technical curriculums to study physics. To the authors was assigned the duty of teaching the required courses. The authors soon discovered that their students, of a lower level of ability, had had courses in mathematics designed for pupils not going to college, had escaped the traditional courses in algebra, and geometry, and had difficulty, therefore, in assimilating the material of the traditional physics courses.

At the start, physics textbooks with the conventional approach and organization of subject matter, demonstrations in which the instructor had all the fun and the students looked on, and individual laboratory experiments were used. The authors found however, that their students did not grasp many of the scientific principles involved in the teacher demonstrations, and the individual experiments were too involved and too unrelated to their immediate problems to challenge them. Interest therefore

was lacking. They then set about trying to find a method that would arouse the interest of pupils, meeting their needs and challenging their abilities.

Through the cooperation of a large number of students, the idea of presenting many simple experiences was evolved. The authors sought demonstrations in many textbooks and other sources. These were collected, rewritten in a simple form, and offered to the classes as *"Experiences in Physics."* As far as possible, each experience was so arranged that questions requiring students to make personal observations and finally to come to a conclusion regarding the principle of physical science in question, had to be made as the student worked. They aimed to have the same principle presented to the students in a variety of situations, thus widening his concept and increasing his interest. They believe that a student, having performed several experiences; all devised to demonstrate, in a different manner, the same idea, would have a more thorough grasp of the physical principle involved.

The experiences and methods of presentations thus organized were tried for several years and finally the plan now in use was fully evolved. This method may be best illustrated by placing it in juxtaposition to the method used in college preparatory physics, more specifically by studying a typical experiment used in the college courses at Thomas Jefferson High School in contrast to the laboratory experiences designed for pupils not going to college.

Experiment on *Reflection of Light* as presented to the college preparatory group.

Object: To study the characteristics of reflection by a plane mirror.

Apparatus: Drawing board; plane mirror; rectangular block; pins; ruler; protractor.

Reference Work: (a) Define angle of incidence. (b) Define angle of reflection. (c) Where is the principle reflecting surface of an ordinary mirror? (d) Where is the principal reflecting surface of a black mirror? (e) Explain what is meant by a real image. (f) Explain what is meant by a virtual image.

Procedure: Part I

(a) Draw a straight line across the center of an unruled sheet of paper. Set the reflecting surface of the mirror along this line.

(b) Draw a line to represent a ray that will make an angle of incidence of about 30°. With an arrow, indicate its direction.

(c) Stick a pin near the edge of the paper so that the bottom of the pin is in line with the image of the incident ray. Draw a line from the pin to the point of intersection of the incident ray and the mirror. Indicate its direction with an arrow.

(d) Measure and record on the diagram, in their proper places the angle of incidence and angle of reflection.

(e) Repeat the above using an incident ray which makes a different angle with the surface of the mirror.

Part II (a) Repeat Part I(a), but this time set a pin (O in diagram) about two inches in front of the center of the mirror. (Figure 1.)

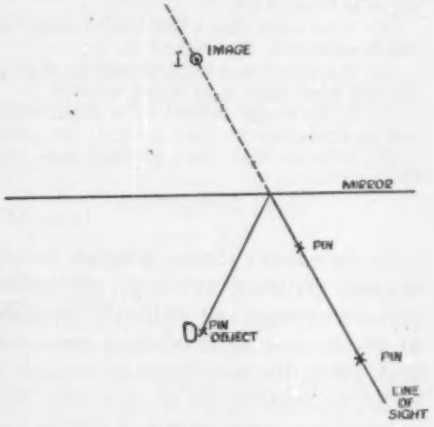

FIGURE 1

(b) Place two other pins, one close to the mirror and one near the edge of the paper (see diagram), in the line of a reflected ray. Draw a line through these two pin points and extend it behind the mirror.

(c) In a similar manner, construct a second line slightly to the right or left of the first. The intersection of the two lines you have constructed locates the image of your first pin. (I in diagram.)

(d) Now draw a line connecting the object and the image. Measure the number of degrees between this line and the line representing the surface of the mirror. This angle should be about 90°.

(e) Measure and record the distance of the object and of the image from the mirror. If the angle above equals 90°, these distances will be measured along the line joining the object and image.

(f) Draw at least two additional lines representing reflected rays as in (a) and (b). Where do all reflected rays intersect? Could light actually come from the image to your eye?

Part III (a) On a new page draw an incident ray making an angle of about 30 degrees and draw its reflecting ray as in Part I.

(b) Turn the mirror through an angle of about 20 degrees and show the new position of the mirror by a dotted line.

(c) Determine the new direction of the reflected ray (using the same incident ray as in III (a)) and show it by a dotted line.

(d) Measure and record the angle through which the mirror was rotated. Likewise measure and record the angle through which the reflected ray was rotated.

Conclusions: (1) Write the relation you found to exist between the angles of incidence and the angles of reflection.

(2) How does the distance of the image behind the mirror compare with the distance of object in front of it?

(3) What angle does a line joining image and object make with the mirror?

(4) If a mirror is rotated through an angle X, through what angle is an image rotated?

(5) Is the image formed by a plane mirror real or virtual?

(6) State at least three practical uses of a plane mirror.

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Instructor

In the physics classes designed for the students not going to college, the authors prefer to vitalize and vivify the principles of physics by a series of short, interesting experiences, the main purpose of which, is to let the students see at once, that these principles are not a number of difficult, isolated, for them meaningless, understandings; but that in them lies the explanation of many interesting facts and phenomena of the world in which they live and have their being—not to be learned merely to pass tests and then be forgotten.

Thus the reflection of light is studied by means of a series of simple experiences, each of which leads the student to a broadening understanding of the same physical principle.

REFLECTION

(As studied by students not going to college)

A. *Images in a Plain Mirror Are Reversed.*

1. Print the following words on a piece of paper; STAR, STUN, TOP, TOT. Hold them in front of a plain mirror and write the words as you see them in the mirror.

2. Hold your left hand to the left of a plain mirror. Does the image in the mirror appear to be your right or your left hand?

3. Place a mirror flat on the table. Hold a pencil perpendicular to the mirror. In what direction does the image of the pencil point?

4. What does this tell you about the images formed in plain mirrors?

5. Lean the pencil so that it makes an angle of about 45 degrees with the mirror. Through how many degrees has the image moved?

B. Image and Object Equal Distances from a Mirror.

1. Set a piece of window glass on edge. Place a lighted candle in front of the glass. Observe the image of the candle in the glass. Place a second candle at the apparent position of the image. Measure the distances of the two candles from the glass. How do these distances compare? (Figure 2.)

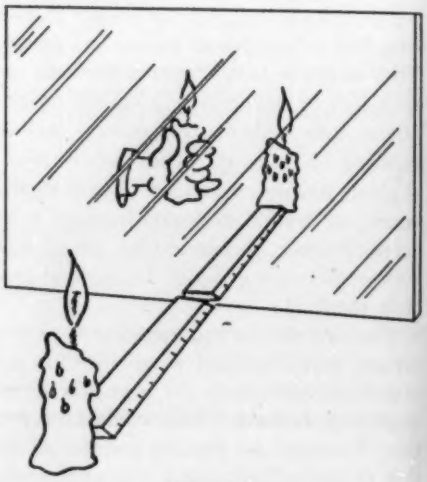

FIGURE 2

C. Picture Traced by Reflection.

1. Place a piece of window glass on edge. Place a drawing on the left side of the glass. Look into the glass from the left side. You will see the reflection of the picture. Place a sheet of white paper on the right side of the glass and while looking through the left side of the glass, trace the outline of the picture. (Figure 3.)

2. Compare the drawing and the original. State the relation between the position of the image and the picture.

D. The Magic Box.

1. Obtain a box fifteen to twenty inches square, and about ten inches high. Place a piece of wood 2/3 the distance diagonally across the corners (H in diagram). (Figure 4.) Place vertically a piece of clear glass (D) across the remaining distance. Cut an opening (E) in the box. (A clear glass may be placed in this opening.) This opening should extend about 1/3 the distance

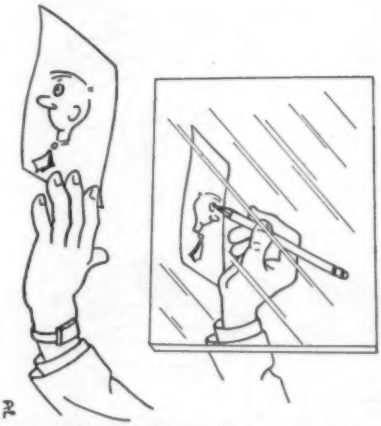

FIGURE 3

across the front of the box. Place a 10-watt electric bulb (F) and a 100-watt elect. bulb (G) as shown. Connect the bulbs to a source of electricity so that each bulb may be turned on or off by switches (K) and (L) respectively. Place baffels (C) to obscure the lights. Place small objects at positions (A) and (B). Cover the box. Look into the opening (E) and turn on light (F). Which object do you see?

2. Turn light (G) on and light (F) off. What seems apparently to take place?

3. Draw the probable paths of light from each object to the eye.

4. If glass (D) were replaced by a silvered mirror, would the same effect be produced?

(Discussions of understandings are left for later class periods.)

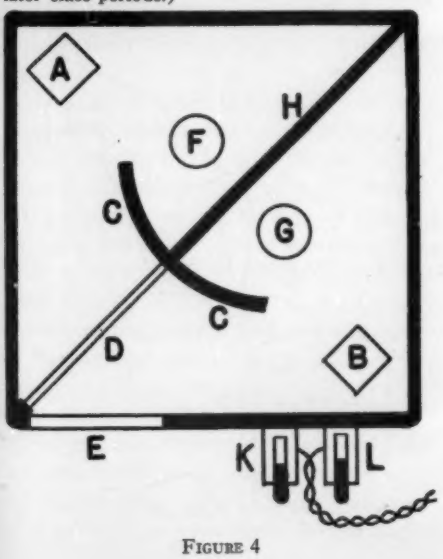

FIGURE 4

In considering the foregoing, it must be kept in mind that these *"Experiences in Physics"* are not experiments to be carried out in a more or less conventional manner with standardized equipment. They lay, rather, the foundation for an understanding of physical principles upon which the student may build by reference reading and they give the teacher in succeeding class periods an outstanding starting point for fixing the principles firmly in the students' minds, and for showing the many applications in everyday life. If members of the class are interested in mathematical relationships these may be presented and the extent to which students may delve into them is limited only by their interest, industry, and intelligence.

Through similar simple experiences students are introduced to all of the principles of physics. Following, as further illustration, are typical experiences dealing with the radio tube.

THE RADIO TUBE

A. Examine Discarded Radio Tubes.

1. Break the glass bulbs of several discarded radio tubes. Describe what you see inside the broken tubes.

B. Edison Effect of a Vacuum Tube.

1. Connect an O1A of 71A type tube in a circuit containing a six volt battery, a 90 volt battery and a D. C. milliammeter as shown in the diagram. (Figure 5.) Close the filament switch and note and record the milliammeter reading.

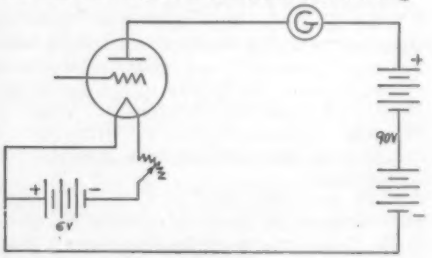

FIGURE 5

2. Open the switch and again note and record the milliammeter reading. What does this indicate?

3. Reverse the polarity of the "B" battery (90) volts, thus making the plate negative. Close the filament switch and note and record the milliammeter reading. What does this indicate?

C. Changing Alternating to Direct Current.

1. Replace the 90 volt "B" battery in the previous set-up with a source of 115 volts alternating current. Turn on the filament switch and note and record the ammeter reading. Since the milliammeter used indicates only direct current, what does this experience show concerning the plate current?

D. Function of the Grid in the Vacuum Tube.

1. Connect a 4½ volt "C" battery to the grid of the tube using a double pole switch. Connect the filament and plate as in part B, question 1. Throw the double pole switch so that the grid is

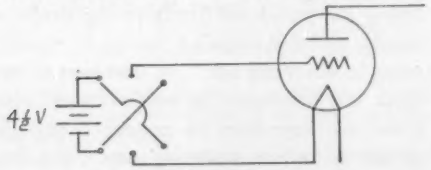

FIGURE 6

negative and note and record the milliammeter reading. Reverse the switch so that the grid is positive and again note and record the plate current. In which case is the plate current higher?

2. Decrease the voltage on the plate from 90 volts to 67½ volts and note and record the change in the plate current. Which will cause the greater change in the plate current, a small change of grid voltage or a large change in the plate voltage?

Following are a few experiences used in the work introductory to a study of Archimede's Principle.

ARCHIMEDE'S PRINCIPLE

A. Apparent Change in Weight of Objects When Placed in Water.

1. Tie an elastic band to a stone. Hold the stone in the air by means of the elastic band. Lower the stone into the water. (Do not let the stone touch the bottom of the container.) What is the apparent effect upon the weight of the stone? (Figure 7.)

2. How is this indicated by a change in the rubber band?

3. Tie an elastic band to a block of wood. Hold the wood in the air by means of the elastic band. Lower the wood into the water. What is the apparent effect upon the weight of the wood?

B. Float an Egg.

1. Place an egg in water. Does it sink or float on the water? (Figure 8.)

2. Place the egg in a saturated solution of salt water. Does it sink or float?

3. Fill a container about half full of salt water. Put a piece of paper on the surface of the salt water to precent mixing and then carefully fill the container to the top with fresh water. Remove the paper carefully and drop the egg into this container. Does the egg sink or float?

Let the jar stand for several days. What happens to the egg?

FIGURE 7

C. Floating and Sinking Objects.

1. Place pieces of balsa, maple, teak wood, cork, a stone, and iron in a container of water. Describe what happens to each piece of material.

Part C of the previous experience appears at first to be very simple. However, students can be divided into three groups

FIGURE 8

Figure 9

—poor, fair, and good—by merely reading their report on this experience. The poor student will say that the pieces of balsa, maple, teak wood, and cork float; the stone and iron sink. The fair student will say that the pieces of balsa and maple wood and cork float, and the teak wood, iron, and stone sink in the container of water. The good student, however, will report that the piece of balsa wood floats with only a small portion under water, the cork with a larger portion under water, and the maple wood floats almost entirely submerged. The stone and iron sink.

As students may carry through many short experiences in a class period, they may perform several hundred during a year.

An effort is made to have students develop the attitude that a knowledge of physics can be a guiding influence in the selection of machines and especially household equipment such as washing machines, sweepers, stoves, and furnaces. In a few experiences which are designed to bring about desirable understanding of practical equipment, the student finds the efficiency of vacuum sweepers, gas stoves, electric stoves, and of such machines as block-and-tackle and chain block.

The general interest in simple everyday problems involving physical principles may be gathered from the large number of questions relating to them heard on the radio today and from the featuring of them in large scale advertisements. Questions such as "Why does snow creak"? "At what temperature will the centigrade and Fahrenheit thermometer read the same?", "May boiling water be made hotter by turning up the gas flame?", are heard over the radio. Ideas relating to practical physical experiences can be obtained by watching the advertisements in the leading periodicals and on bill-boards. The tensile strength of bed sheets is connected with the tensile strength of common cord. Testing the strength of automobile parts are often illustrated. A recent advertisement showed a picture of the standard kilogram kept at the Bureau of Standards. If these ideas are of interest great enough to be featured in advertisements costing thousands of dollars, they must possess enough interest to form the basis of experiences for students who will use these products in their everyday lives.

Because a large number of small experiences are used instead of a few formal ones, a great deal of expensive equipment need not be purchased. Many experiences can be performed by using standard physics equipment already on hand. Discarded parts of automobiles such as the thermostat, carburetors, and speedometers may be gradually collected and an electric grill or hot plate which will serve in finding the efficiency of electrical heating devices may be purchased cheaply. Materials of like nature, for experiences in other units may be easily gathered.

Each report contains certain vital points which can be checked quickly. If desired, a short weekly test on the week's laboratory work covering the main points, the understanding of which is of value to the students, can be given. Because the accuracy of the student's observation and the understanding of the principle is emphasized, there is little tendency to judge the student on how well he writes or how well he draws diagrams. The teacher will remember that

slow learning pupils often have poor penmanship and are not always the neatest persons in the world. With this method and these ideas in mind, checking reports is not a pedagogical bugbear.

Certainly the materials of physics touch our everyday life to such an extent that none of us would say, "Drop it from the curriculum." Yet it is a well-known fact that only about 6% of the present high school graduates have had a course in physics. This is so, partly because of the increase in number of the general science courses. However, the many articles and comments on this subject indicate that general science in the ninth grade of school does not meet the scientific needs of high school students interested in obtaining a general education. Much of our trouble lies in the methods of presenting high school physics to the students.

These experiences are presented to explain the pupil's environment, not in terms of abstruse technical accuracy, but in such familiar and homely phases and proof as are compatible with his limited ability and mode of life. This type of student will always have a limited outlook and environment, but if we can bring him to the point where he can understand and control his environment, however limited, we shall have produced in a measure at least an intelligent and happy human being, from the standpoint of physical environment. Carlyle has said that the only true happiness of a man is reached by clear decided activity in the sphere for which, by nature and circumstance, he has been fitted.

PERSISTENT LIFE PROBLEMS AS A BASIS FOR SCIENCE EDUCATION

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During the past four years we have been developing an educational program at New College Community in which science is a conspicuous feature. The Community is a farm, fitted to accommodate as many as one hundred students, in the mountains just west of Asheville, North Carolina. New College Community is a branch of New College of Teachers College, Columbia University. New College is devoted to the training of teachers on an undergraduate level and each student is required to spend a certain amount of time at the Community. The science work here has been made an integral part of our New York program and, we feel, accomplishes much which cannot be done in lecture room and laboratory.

The chief purpose of New College Community is to provide an experience in intimate group living in a rural environment, and at the same time abundant opportunities for instruction in the natural sciences are available. Some eighty acres of land are in cultivation. There are cows, pigs, chickens, and other farm animals. We supply our own meat, vegetables, eggs, butter, and milk. We generate our own electricity with an overshot waterwheel. We have to provide ourselves with water, proper sewage disposal, *etcetera*. If any student were to be thoroughly acquainted with all of these problems of living, he would indeed be well orientated in the field of natural sciences.

One of the basic philosophies of New College is that the experience of students should be co-extensive with life. Thus, the curriculum is organized not about subject matter fields, but rather about a group of persistent life problems which are inescapable in the life of any individual. We have stated some of these problems as follows:

1. Adjustment to and cooperation with others.

2. Adjustment to and control of the natural environment.
3. Achievement and maintenance of physical and mental health.
4. Raising the standard of living.
5. Achievement of economic security.

This list is not complete and merely gives examples. Our curriculum, therefore, is intended to teach principles which will function in the lives of the students in helping them face these persistent problems.

Perhaps the most important feature of New College Community is that all of its problems of existence are faced entirely by the staff and students as a group. Most of the problems which face society as a whole must be faced here on a smaller scale. We believe that some direct experience with these problems at the Community will go a long way toward preparing the student to react intelligently to the same problems in later life. This direct experience must be made to result in learning general principles which are applicable to other situations. These principles must be stated and then recognized as objectives in our instructional program.

Instruction in the natural sciences enters chiefly into the problems relating to the control of the natural environment and the achievement and maintenance of good health. Thus, we have units entitled "Food production and preservation," "Sanitation," "Health and First Aid," "The Control of Energy," and others. As an example, I shall discuss the unit of "The Control of Energy" in more detail.

The control of energy involves the problems of getting heat, light, water, transportation, and communication. The unit is organized about these problems and certain fundamental principles have been formulated to serve as major objectives. Three such principles are:

1. The sun is the source of most available energy.
2. Energy may be transformed from one form to another.
3. Energy may be stored in various forms.

It is further necessary to state a number of more specific principles to be recognized as minor objectives, the association of which will lead to an understanding of the more general principles. Examples of these for the second major objective are:

A. Potential energy stored in water may be transformed into mechanical energy.
B. Mechanical energy may be transformed to electrical energy. (When a conducting material is moved through a magnetic field, a difference of potential is induced.)
C. Energy stored in organic material is released as heat when that material is oxidized.
D. Heat may be transformed to mechanical energy through the expansion of hot gases.

All of these principles must then be taught with the use of as many learning experiences as are necessary. Foremost among these experiences are definite activities associated with the problems previously stated. For example, our hydroelectric plant had to be built to get light and now that it is built it must be maintained. A project of this sort does not have the artificial aspect frequently found in science laboratories and it has the additional advantage of being something which must be done or the group will have no electricity for lights. This gives it a vitality and importance which arouses a more genuine interest in the student who, therefore, may learn the principles more rapidly. Whenever there is an inquiry into why the waterwheel is twenty-four feet in diameter instead of, say, twelve feet, then is the time to give instruction in how much horsepower may be developed with a certain amount of water and how much electricity may be generated. This instruction may be given to the student while he is busy repairing a leak in the flume, or he may be asked to go to the library to use any materials which have been made available, or the matter may come up in the regularly scheduled lecture period. Thus, if a phys-

ics text is studied, it is studied not just to study physics but as an aid to discovering something which the student wants to know. This gives a more objective basis for the choice of the curriculum than simply whether or not it is in the textbook.

I shall describe further our hydroelectric plant in order to point out more of its educational value. It was installed by a group of students and me shortly after the Community was organized. It was necessary to estimate the power consumption in watts, the flow of water in our stream, and the probable efficiency of the plant, in order to calculate the size of the wheel. The ratio of the speeds of the waterwheel and generator had to be determined and gears, belts, and pulleys of the proper size had to be obtained. The buckets of the wheel had to be designed to retain the water as long as possible. A switch-board had to be installed with ammeters and voltmeters connected in the proper way. Storage batteries were obtained and connected in such a way as to store excess energy and release it when the demand becomes greater. The batteries had to be placed near the center of our power system so that the voltage drop would not be excessive in its extremities. All of these problems and many others offer abundant opportunities for instruction in natural science. Further questions can be asked, such as why the stream falls at certain times of the year, why the stream does not dry up completely during dry seasons, and why poplar was the most suitable wood to use in the wheel.

The question naturally arises as to how this technique applies after the plant has been installed. We have found that it loses none of its educational value. We can still raise the question as to how we get our electricity; the plant must still be maintained; there are occasional breakdowns which must be repaired; and the plant is always in need of improvement. All of these same problems may come up again with each new group of students. The principles may be taught in the same way but varied according to their ages and previous experience. With older students it is possible to state principles requiring a wider variety of experiences and then go into the problems in greater detail. It is quite natural to ask the nature of the electric current which we are inducing.

All of this discussion about the unit on "The Control of Energy" has been relative to the one problem of getting light. A similar program of instruction has been worked out for each of the other problems. Our furnaces and stoves must be kept in order. We have a number of automobiles which must be kept in good condition. We are at present installing a two-way telephone between some of our buildings which are about a mile apart. Each of these problems involves fundamental principles which can be taught through the activities necessarily associated with them.

A short while ago I stated that the principles were to be taught with the use of as many different learning experiences as are required. This implies the establishment of some objective basis for determining when a principle has been learned. We believe that a principle has been learned when it can be shown that it functions in the thinking of the student. Thus, the student would not be asked merely to state the principle in an examination. Nor would he be tested merely for his mastery of facts. One question might be stated, "If as a teacher you went into a small town which had no electricity or inadequate electricity and, being a teacher, you were interested in the welfare of the community, what are all the factors which you might consider in helping them meet that problem?" The student should be allowed plenty of time with a question of this sort and the answer should be carefully scrutinized to discover evidence of certain principles functioning in his mind. Furthermore, in observing the student's responses to situations in or out of class, much evi-

dence of his progress may be secured. We have a system of recording such evidence that may be obtained by an instructor. An examination program of this sort is difficult at best, but we hope we are making some progress in the right direction.

Another phase of our program which we are beginning at New College Community involves the same technique of instruction; but the persistent life problems are on a larger scale. Our farm is in a rural mountain region which is badly in need of development. The mountaineers have exhausted their forests which have been their chief means of livelihood; their housing conditions are poor; their land has been depleted; their health is poor; and yet they are a fine stock of English and Scotch-Irish descent who are anxious to meet their own problems and improve their living conditions. This is challenge to us to be of some help to them and, at the same time, the same life problems are presented which furnish opportunities for our instructional programs. As a group, we and the mountaineers, are trying to develop a program for reforestation, proper soil use, improved health, developing an income, and for getting electrical power. Many opportunities may here be found for teaching principles from the fields of geology, biology, and physics, as well as social science.

Now the problem of applying this teaching technique to other situations comes up. Most schools do not have to face the problems of living so directly. These problems are faced by others. The janitor is hired to make certain that the buildings are properly heated. The electricity is bought from the local power company, and so on. The set-up is certainly not so well suited to this technique. However, we believe that much can be done to make use of those things that are suitable.

The student could be made aware of these problems in every possible way. There is no reason why the science class should not be thoroughly familiar with how the building is heated. If at all possible they might take part in some way. There is no reason why the science class should not be thoroughly familiar with the local source of electrical power. If the school bus needs repairing, the class could study this carefully. The same problems of living are again evident and can be used as a basis for the choice of the curriculum. The principles may be stated and recognized as objectives for teaching.

There are certainly many difficulties associated with carrying out a teaching technique of this type; but we believe it offers a vital basis for giving instruction which adds to the interest of the students and enables them to learn more effectively.

THE INTEGRATION OF SOME FORMS OF MULTIPLE CHOICE TESTS FOR INSTRUCTIONAL PURPOSES IN PHYSICS

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Instructional tests are one of the least developed of the various instruments of evaluation. Intelligence tests, standardized subject matter tests, and objective achievement tests in the various teaching fields have thus far received the greater emphasis. Recently, however, unit tests for instructional purposes have received more consideration from test makers. This study has revealed the need for new techniques in the construction of tests which are to be used as teaching devices. Such a need may be demonstrated clearly by making an inventory of the purposes for which such tests are intended and by evaluating existing techniques by reference to this list.

In common with new-type tests which cover an entire teaching field, an instructional test should be valid, reliable, and objective. If these characteristics are satisfied the test may be used as a measure of achievement, not only in an entire field but in various areas of the subject. Unlike the objective achievement tests in a given subject, the unit instructional test must not only measure but also teach. The items must not only constitute a representative sampling of the unit, but they must be selected so as to satisfy the teaching objectives of the unit. Moreover, the parts of an item and the items themselves should be grouped in such a way as to facilitate learning. In order to teach, the test must be diagnostic; it must point specifically to definite errors in the learning process. This demands that the items cover small units of work and be of such form as to permit of ready analysis not only for the individual but for a particular group. In summary then we may say that unit instructional tests must cover sufficiently small areas so as to be diagnostic, must group the facts within an area so as to facilitate learning, and must be sufficiently valid, reliable, and objective to measure achievement.

Let us now examine existing techniques in the light of these criteria. Two types of techniques are in common use, the recall and the recognition. The recall technique embraces such forms as the essay type test, the short answer test, and the one-word completion test. The recognition technique includes the true-false test and the multiple choice tests. The latter may require the choice of the right answer or of the wrong answer from a list of from two to numerous responses, and may be arranged in paragraph form, in vertical columns for matching, or in the so-called master-list technique. Which of these techniques are best suited to the purposes which we have set up for unit instructional tests?

The recall technique may be made to cover small units, and lends itself to the grouping of responses. In so far it is instructive and diagnostic. However, it does not permit of ready analysis, and provision must be made for too many variable responses in the item study form. Hence, responses are not easily diagnosed for a group study. Moreover, it is extremely difficult to make recall tests thoroughly objective and reliable, even though they may have a high validity.

Notwithstanding these objections, present instructional tests have drawn largely on the recall technique. This is not hard to understand when we realize that many testmakers still feel that the recall technique tests something that the recognition test does not. Recent studies, however, tend to overthrow this conclusion, and to show that the ability to recall correlates to a high degree with the ability to recognize.

Of the recognition techniques, the true-false, or a combination of this with the recall technique known as the modified true-false, has been most commonly used by the makers of unit instructional tests. Since the latter has all of the disadvantages of the recall test, it will not be considered further. Instead we shall evaluate the true-false technique in the light of our criteria. This technique may be adapted to small units, and may be used to diagnose particular facts. As an instructional form, however, it leaves much to be desired. Not only does it not group facts so as to facilitate learning, but it defeats the learning process by encouraging guessing and discouraging synthesis and organization.

The multiple choice tests enable one to group the individual true-false statements in such a way as to facilitate the organization of facts. However, it is difficult to cover small units of work with the multiple choice techniques. Thus, the diagnosis of particular learning difficulties is impossible.

The multiple choice techniques discourage guessing to such an extent that it may be ignored from the standpoint of statistics. This guessing, however, is significant from an instructional point of view. This may be illustrated by reference to a particular

item in the right answer form of the multiple choice test. Consider the following example:

4 (1) Substances which are solid at ordinary temperatures include 1. gasoline; 2. kerosene; 3. benzene; 4. paraffine.

If the student is now instructed to place the number of the one right answer on the blank, he is expected to make four true-false decisions, namely:

F (a) At ordinary temperatures gasoline is a solid.
F (b) At ordinary temperatures kerosene is a solid.
F (c) At ordinary temperatures benzene is a solid.
T (d) At ordinary temperatures paraffine is a solid.

Now if we wish to correct the student's score for guessing on a series of such exercises, we usually use the formula:

$$\text{Score} = \text{Number right} - \frac{\text{Number Wrong}}{(N-1)},$$

where N stands for the number of possible responses to an exercise.

In this case N = 4. Thus, the formula becomes:

$$\text{Score} = \text{Number right} - \frac{\text{Number Wrong}}{3}$$

Statistically, the correction is probably not essential. In other words we arrive at the score by counting the number of right responses and ignore the correction for guessing.

From an instructional standpoint, however, the guessing is significant. To illustrate, suppose the student knew that gasoline, kerosene, and benzene were not solids, he could immediately write the correct response since he knows that one of the four responses must be right. He may or may not know that paraffine is a solid. Thus, the item has failed to diagnose the student's response in regard to paraffine.

In order to diagnose each response, the directions for a right answer test could be stated as follows: On the blank before each sentence place the number of any ending which is *correct;* if no ending is correct, place a zero (0) on the blank.

The following item illustrates the use of the zero variation suggested by these directions:

0 (4) Substances which are solid at ordinary temperatures include 1. gasoline; 2. kerosene; 3. benzene; 4. water.

In this way we force the student to make a true-false decision on each part of a given exercise, and the guessing may be ignored from a statistical point of view.

The zero variation may be used in any of the multiple-choice techniques.

The following directions and exercises will illustrate its use in the wrong answer type of response: On the blank before each sentence place the number of any ending which is incorrect; if all endings are correct, place a zero (0) on the blank:

4 (3) Substances which are liquid at ordinary temperatures include 1. gasoline; 2. kerosene; 3. benzene; 4. paraffine.
0 (2) Substances which are liquid at ordinary temperatures include 1. gasoline; 2. kerosene; 3. benzene; 4. water.

The zero variation, however, does not overcome all of the objections which we raised to the use of the multiple-choice techniques for instructional purposes. We shall still find it difficult to cover small units of subject matter with these techniques. This probably explains why they have been used so sparingly by the makers of instructional tests.

Thus, we see that each of the common techniques (as well as some not so common) fails to achieve some one of the requirements which we have set up for an instructional test. Some testmakers have overcome this difficulty by using a combination of techniques. One common combination is that of the completion and true-false techniques. Any such combination, however, will have the disadvantages of the various techniques employed, and will com-

plicate analysis for group diagnosis. The primary advantage of a combination is to enable the examiner to cover smaller units than he could otherwise.

Another possibility, and one so far ignored by testmakers, is to integrate various testing techniques so as to satisfy the requirements of tests for instructional purposes. Such an integration will constitute the remaining paragraphs of this discussion.

It has been pointed out that the recognition techniques are to be preferred to the recall techniques for the purposes of objective measurement. Moreover, the assumption has been made that the abilities measured by the two techniques correlate to a high degree. Further, the opinion has been expressed that, of the recognition techniques, the true-false is least efficient in the promotion of the learning process. Consequently, this suggested solution to our difficulties is an integration of the multiple choice techniques. Not only will the right answer type of response be integrated with the wrong answer type, but also the zero variation which we have previously suggested will be incorporated in this synthesis.

The following directions will illustrate the nature of the proposed integration:

Show your understanding of the items by marking in one of four possible ways:

(1) On the blank *before* any sentence in which *only one* ending is *correct*, place a capital letter R (R = *R*ight) followed by the *number* of the *one correct* ending.
(2) On the blank *before* any sentence in which *all* endings are *correct*, place a capital letter R (R = *R*ight) followed by a capital letter A (A = All).
(3) On the blank *before* any sentence in which *only one* ending is *incorrect*, place a capital letter W (W = Wrong) followed by the *number* of the *one incorrect* ending.
(4) On the blank *before* any sentence in which *all* endings are *incorrect*, place a capital letter W (W = Wrong) followed by a capial letter A (A = All).

Each of these types of responses is illustrated by exercises numbered to correspond with the directions given above and with the exercises previously used in this discussion:

R 4 (1) Substances which are solid at ordinary temperatures include 1. gasoline; 2. kerosene; 3. benzene; 4. paraffine.
R A (2) Substances which are liquid at ordinary temperatures include 1. gasoline; 2. kerosene; 3. benzene; 4. water.
W 4 (3) Substances which are liquid at ordinary temperatures include 1. gasoline; 2. kerosene; 3. benzene; 4. paraffine.
W A (4) Substances which are solid at ordinary temperatures include 1. gasoline; 2. kerosene; 3. benzene; 4. water.

A comparison of the four exercises above with the four previously used will show that the integration has been effected by the use of the letters R and W and the changing of zero to the letter A. Any one of the ten possible responses; namely, R 1, R 2, R 3, R 4, R A, W 1, W 2, W 3, W 4, and W A, will immediately show the nature of the student's reaction to a particular item. Thus, in item (1) above, "R 4" shows the instructor that the student knows that paraffine is the only solid in the list. The use of the numeral "4" alone, as in the common type of right answer test, would not show this since, as we have shown, the student might reach this decision by knowing that one of the four answers must be right.

The above is not intended to imply that no guessing occurs on the integrated technique. In the suggested form the student is required to make four true-false decisions. Of course by increasing the number of endings for each item to five instead of four, he would be required to make five true-false decisions. Similarly, for any number of suggested endings. From a statistical point of view four seems to be a sufficient number to eliminate any correction for guessing. From an instructional point of view four is more desirable than five since it increases the number of items possible from a given unit of work.

Indeed at times it will require careful inquiry to find our endings that go together to make an instructive test item.

The extent to which a given response is influenced by guessing depends on the number of true-false decisions which the student is able to make correctly. A student who is able to make three out of four correct decisions will have a fifty-fifty chance if he guesses on the fourth decision. Similarly, a student who makes two correct decisions and guesses on two has one chance in three. Again, a student who makes one correct decision and guesses on three, has one chance in five. Finally, a student who guesses on all four decisions has one chance in ten. Thus, the effect of guessing in increasing a score progressively diminishes as knowledge decreases. Of course the above analysis assumes not only that the student is able to make the necessary decisions, but also that he is able to select the possibilities from which to make his guess. Lacking the latter ability, the chances of a correct guess are diminished to a still greater degree. Thus the integrated multiple choice technique in minimizing the effect of guessing on a student's score will tend to discourage guessing and increase the accuracy of diagnosis.

Not only can particular errors be diagnosed with greater accuracy by the integrated technique, but diagnosis can be accomplished as easily as with any combination of existing techniques. For purposes of group diagnosis, the tabular arrangement shown in Figure 1 will be found helpful.

After the individual errors have been tabulated on such a form, the instructor can analyze the more serious errors. Remedial work can follow such an analysis.

Moreover, the difficulty of particular items can be calculated in terms of the per cent responding correctly to each item by dividing the number of correct responses by the total number of cases. This data is shown on the item study form. If desired, an additional column may be added for the difficulty of the items. The validity and reliability of a battery of items can be determined by any of the accepted methods.

Thus far, an attempt has been made to show that the integrated multiple choice technique is diagnostic and objective. Instructional tests constructed by the author

Total Cases =

Item Number	*Tabulation of Omitted Responses*	*Tabulation of Incorrect Responses*										*Total Number Incorrect and Omitted Responses*	*Total Number Correct Responses*
		R					*W*						
		1	2	3	4	A	1	2	3	4	A		
1													
2													
10													

FIGURE 1.—Item Study Form

and used in his classes have shown batteries of items using this technique to have a high validity and reliability. A discussion of these is beyond the scope of this paper. However, before concluding this discussion, it is necessary to show that the suggested technique for instructional tests meets the criteria which we have set up.

A criticism of the true-false technique was made because it failed to organize its facts. The integrated multiple choice technique is well adapted to the grouping of facts which belong together. This can be shown by listing items which have been used in the Ohio Scholarship Tests:

W 2 (a) If a ball is dropped from the top of a tall building, quantities which will increase as the ball continues to fall include (1) velocity (2) acceleration (3) momentum (4) kinetic energy.

W 1 (b) Galilei Galileo and Sir Isaac Newton resemble each other in that both (1) supported the wave theory of light (2) made contributions to our knowledge of mechanics (3) experimented with telescopes (4) were leaders in the development of experimental science.

R 4 (c) The rate of evaporation of water from a body of water increases with a decrease in the (1) area of the surface (2) temperature of the water (3) movement of the air over the water (4) relative humidity of the air over the water.

R 1 (d) The electrolyte in a lead storage cell (1) has a greater specific gravity when the cell is fully charged than when it is discharged (2) freezes at a higher temperature when the cell is fully charged than when it is discharged (3) should be tested with an hygrometer about every two weeks (4) should never be allowed to cover the plates of the cell.

W 1 (e) When fifty grams of steam at 100 degrees centigrade are changed to ice at five degrees below centigrade zero, the number of calories of heat liberated in (1) changing the steam to water at 100 degrees is 4000 (2) cooling the water from 100 degrees to zero degrees is 5000 (3) changing the water at zero degrees into ice at zero degrees is 4000 (4) cooling the ice at zero degrees to ice at negative five degrees is 125.

It has been suggested that a possible reason for the limited use to which the multiple choice techniques have been put in the construction of instructional tests is the difficulty of framing sufficient items for small units of study. The integration of these techniques gives a wider range to the testmaker. In the teaching of mathematics and the natural sciences, the author has had no difficulty in framing at least ten items for a unit of study to which one week had been allotted. Usually the required number of items has had to be selected from a much larger group.

In addition to the characteristics listed above for the integrated multiple choice instructional test, brief mention of certain other important traits should be made. The instructor may construct many forms of the test having entirely different keys but containing the same subject matter. This is done by interchanging the endings in the items on the various forms. The procedure is useful in groups where students are seated closely or for use in various sections of a subject. The test may be used to rank students in their achievement on a particularly unit and on cumulative units. The technique eliminates the necessity of repeating directions for each test. One sheet of directions is given to each student at the beginning of a course. The instructor can group the items on a particular test according to objectives rather than according to testing technique. Pupils readily become acquainted with the technique. As a whole student rapport is high. The instructor can maintain one file of test items arranged according to the objectives of the units of study rather than several files organized according to testing technique. The test is easily scored by the students themselves during the class period. Thus, the integrated multiple choice instructional test, while having certain distinct advantages over other forms, does not sacrifice certain traits regarded as desirable by testmakers.

Classroom Notes

Originality in Scientific Models.—As teachers of science, we are aware of the pupil, who for the first time, shows tremendous enthusiasm for some particular subject or experience he encounters in the classroom.

In general science it is recognized more and more that one way this interest may be encouraged is to allow a boy or girl to create some project relative to the lesson unit. As much as possible the pupil should be given an opportunity to select, carefully plan, and then finally build the project. Of course, if a teacher is on the alert, he can do much to accomplish a wise selection. By continuous visits to museums, libraries, expositions, hobby shops, and industries one should discover those subjects which have not been explored and the improvements needed for those already done. Occasionally, some department stores furnish attractive, educational, and scientific displays that bear directly on the material discussed in class. Then again, up-to-date science textbooks, newspapers, and such current magazines as *Popular Science Monthly, Popular Mechanics, Mechanics and Handicraft,* and *Modern Mechanix* should serve as an excellent background for development of originality in this work.

The Newark Pennsylvania Railroad Station model, which the writer is about to describe, was a pupil's own choice. This activity was carried on outside of school during leisure time.

The following brief description of this project is offered with the hope that it may be of service to others who wish to reproduce this station or some other at a future date.

The white base is constructed of three-ply wood measuring 24 by 14¾ inches. The light gray building, made of balsa wood, stands 5½ inches high. It is composed of five sections. Each part is ¼ of an inch in thickness with the exception of the front piece which is ½ of an inch. The dimensions are 20⅜ by 6½ inches. The pieces are fastened together by common pins cut short to keep them from bending.

The most intricate part of the work to achieve is the beautiful ultra-modern design surrounding each window. These windows were assembled from numerous small strips of wood 1/16 of an inch in thickness interlocking with each other. The effect resembles the inside of an egg box. Cellophane was substituted for glass in all windows.

Other interesting details are: the clock with its painted figures; the insignia; the two canopies supported by small braces; the two rows of seats in the station; and the different panels on the walls. A knife was the only tool used to build this project. The cost of materials was approximately $2.50.

The model, which was exhibited at the North Jersey sectional conference of the State Science Teachers' Association aroused great enthusiasm among the members of our general science classes. Pupils have already begun to work out new ideas with the hopes of displaying their projects at some future exhibition.

A pupil needs an opportunity to test his capacities in various ways. After his true interests are discovered, an opportunity should be given to select and pursue activities that harmonize with his tastes and abilities. The school must meet the youth on his own ground—not by repression, but by expression through interesting and well-planned channels.

MAITLAND P. SIMMONS,
Irvington High School,
Irvington, N. J.

A Visit to a Dairy.[1]—As we leave the busy office of the Puritan Dairy behind us we enter a large and light room filled with huge tanks and oddly shaped machinery. The tile floors, especially built for the dairy are still wet from the last steam cleaning the dairy received. It takes hours to clean the dairy and the equipment is sterilized for 45 minutes after each using.

The purpose of most of this machinery is to pasteurize the milk. Pasteurizing is the heating of the milk to 144 degrees Fahrenheit for thirty minutes. The purpose of pasteurization is to kill most of the harmful bacteria. Milk that has not been pasteurized may cause diseases such as septic sore throat, tuberculosis, typhoid fever, etc. Nine tenths of the boards of health of various cities do not permit the sale of unpasteurized milk.

Grade A milk must not have a bacterial count of more than 100,000 bacteria per c.c. for raw milk or 10,000 bacteria for pasteurized. Grade B milk must not have a bacteria count of more than 300,000 per c.c. while raw or 30,000 per c.c. when pasteurized.

The board of health checks up on these requirements by the following method:

Each day the board of health sends out a man to meet the different milk trucks and pick out any bottle that he wants.

He brings the milk back into the laboratory before 9:00 A. M. and the milk is placed in a refrigerator.

First of all, a test for bacterial count is made. They take 99 c.c. of distilled water and add to it 1 c.c. of milk. They mix this thoroughly thus making a solution of 1 to 100. Many times as an

[1] A regular and original classroom report of a trip prepared by a student and submitted by Leo W. Klein, Teacher, Perth Amboy, New Jersey, High School.

added precaution, they take 1 c.c. of the 1 to 100 solution and mix it with 9 c.c. of distilled water thus making a solution of 1 to 1000.

They then take several sterile petri dishes and put 1/10 of this solution into several of the petri dishes with a plating of sterile-agar-agar. They then put it in a incubator and keep it at body heat (98.6 degrees Fahrenheit) for 48 hours.

Then they take it out and with a large magnifying glass, count the colonies of bacteria. They know that each colony originated from one bacteria. They take this number and multiply it by the amount of dilution and therefore get the number of bacteria per c.c. in the milk.

Later on they make the test for butter-fat content. First they mix each bottle of milk thoroughly in order to mix the cream with the rest of the milk. Then they take 17.5 c.c. of milk and mix it with an equal amount of diluto-sulphuric acid in a Babcook butter-fat test bottle. This bottle is a small bottle with a long, narrow, graduate tube at the top. The sulphuric acid dissolves everything in the milk except the butter-fat which floats at the top. Then hot water is added and mixed in a machine by centrifugal force in order to bring the butter-fat into the tube at the top. The butter-fat is yellowish in color and the per cent is then read and marked down on a record sheet.

The minimum requirement is 3% and most of the milk average about 3.8% butter-fat.

If the milk is deficient in any of the requirements an inspector is sent to the plant to help remedy the trouble.

But now let us see how the milk is pasteurized. When the milk is first brought in from the dairy, an agitator is used on it, to break up the fat globules and to distribute the cream throughout the milk. If the agitator were not used some customers would get all the cream and others all the milk.

After that the milk is sent up in a pipe to the huge glass lined tanks where it remains at a constant temperature below 38 degrees Fahrenheit. If the milk is allowed to get any warmer bacterial growth will be encouraged and the bacterial count will be too high.

When it is time to pasteurize the milk is passed through a long tube called a preheater. Then it is put in another tank called a precision heater. The milk is then held at 144 degrees Fahrenheit for thirty minutes. The thermometers on this heater are so delicate they must be checked daily. When the milk goes to the precision heater it first must pass through an extra filter to be doubly assured it is filtered. For when the farmer weighs it he must also filter it. As soon as the thirty minutes are up the milk is automatically dropped from the precision heater and cooled aumost instantly. It is cooled by passing over a series of pipes which contain a mixture of water and brine. The water is to prevent the brine from being too cold.

The milk is then kept below 38 degrees F. for the rest of the time. The milk is then sent down the pipe to be bottled. Before the milk is bottled the bottles and cases must also be washed or sterilized. The bottles and cases are placed on moving belts to facilitate their washing. The belt that carries the cases is the only one of its kind in the east. As we follow the milk on its journey we notice every process takes place in a different way. This is to help keep the place as clean as possible.

But now the milk is bottled and ready to be distributed. It is interesting to think that during the whole process the milk has never been exposed to the air once. This is of course to prevent it from picking up any bacteria.

But from all these precautions you must not think all bacteria harmful. Bacteria is the basis of almost all health changes. A certain type of milk called Acidophalos milk even has bacteria added. This bacteria forms lactic acid which stops fermentation in the intestines. This is used for certain types of intestinal disorders.

With all these precautions to prevent the spread of disease the employers too must be examined to prevent the spread of disease. They are examined to get their health cards. And they must have their health cards in order to work.

Some people say that the pasteurizing of milk kills the vitamins in it. It is however only a theory and the benefits derived from pasteurized milk are proven. Others say that milk should not only be pasteurized but homogenized. Homogenizing is the heating of milk to 180 degrees Fahrenheit. This does not do the milk any harm but it gives it a cooked taste. The sale of homogenized milk is not permitted in Perth Amboy.

An example of how the place must be kept is observed in the windows. They are kept so clean that they get unremovable steam spots on them and must be replaced annually.

Of course all these efforts to keep the dairy clean and spotless are useless unless you take precautions with the milk that reaches you.

Digests of Unpublished Investigations

METHODS OF DETERMINING TYPES OF CONTENT FOR A COURSE OF STUDY FOR EIGHTH-GRADE SCIENCE IN THE HIGH SCHOOLS OF THE SOUTHERN APPALACHIAN REGION[1]

FEASTER WOLFORD[2]

UNIT I

Problem.—To determine the objectives of education in general, and of courses of general science in particular.

Method.—An extensive analysis was made of articles and sections of books dealing with the objectives of education and of general science, to determine the nature of these objectives and the extent to which the objectives of education and of general science agree.

Conclusions.—(1) "Educators seem universally agreed . . . that the objectives of education should be based upon an analysis of the activities of life, but there is a difference of opinion as to what to include in the analysis. Most educators would use as a basis the things individuals do, but some would have as a basis what individuals should do in a well-ordered society."

2. "Several authorities seem to emphasize the utilitarian value of education by emphasizing the development of knowledge and skills in order to perform the activities met in everyday life. Others emphasize the importance of developing the personality of the individual through the creating of proper attitudes, habits, interests, standards, and ideals."

3. "There is no general agreement as to the character of objectives for science in the junior high school, but most authorities emphasize the ideas of exploration, stimulation, guidance, and adjustment to the environment. There appears to be no conclusive method of evaluating objectives. . . ."

4. "In the courses of study the specific objectives for science are not always in harmony with the general objectives."

UNIT II

Problems.—(1) To determine the extent to which the subject-matter in the science textbooks now used in the various states of the Southern Appalachian Region is applicable and adapted to the pupils in the high schools of the region; and (2) to study the organization of material in these books in order to classify under appropriate headings the material secured in the study.

Method.—An analysis was made of 10 textbooks of general science to note the extent to which their authors agreed on what is essential in a general science course. The results of this analysis were compared with those of similar analyses. A further analysis was then made of 8 other general science texts, none of which was more than 6 years old, in order to "find both the content and the organization of subject-matter." The amount of space devoted to each subject-matter unit and to each "activity situation" was determined in square inches of space in the books, and the average space devoted to each was computed.

Findings.—(1) ". . . there is very little agreement among writers as to what should be included (in a textbook of general science), and . . . no attempt has been made to prepare a textbook that is specially adapted to a particular region."

[1] The Southern Appalachian Region includes Alabama, Georgia, Kentucky, North Carolina, South Carolina, Tennessee, Virginia, and West Virginia.

[2] Unpublished Dissertation for the degree of Doctor of Philosophy, Cornell University, 1935.

UNIT III

Problem.—To determine the nature of state courses of study in general science.

Method.—All the courses of study for those states of the Southern Appalachian Region which included in their courses materials concerning science, namely, North Carolina, South Carolina, Virginia, and West Virginia, were compared with the courses of study for Missouri, Texas, Montana, New Mexico, New York, New Jersey, North Dakota, and Iowa; and also with those for the city schools of Denver, Saint Louis, Baltimore, Detroit, and Philadelphia.

Findings.—(1) "The courses of study for the region included are the results of the opinions of high school teachers, state school administrators, and college professors. No analysis has been used as a basis."

2. ". . . while city schools may provide their own [courses of study], teachers in small town and rural high schools must either make their own . . . or lean heavily on the adopted textbooks. They usually do the latter."

3. "The materials in the courses of study are too often determined or influenced by the adopted textbooks, which are usually written to meet conditions in large urban centers, rather than small-town and rural communities."

4. "While the producers of courses recognize the variations that need to be made for such communities, they make no provisions for such variations."

5. The treatment of the subject in state courses of study is too brief to be of great value. "A comparison of the four state courses of study with courses of study for city schools shows that the former devoted approximately only one-ninth as much space to eighth-grade science, and one-fourteenth as much space to science content as the latter."

UNIT IV

Problem.—To determine (1) the occupations of the fathers of children living in the mountainous sections of the region,[1] who were studying eighth-grade science; (2) the vacation activities of these children; and (3) the occupations in which they planned to engage.

Method.—A questionnaire was submitted to eighth-grade pupils of the region, requesting them (1) to state their fathers' occupations; (2) to state the occupations in which they themselves engaged during vacations; and also, (3) to list, "in order of the greatest likelihood," the 6 occupations in which they would most likely engage. An analysis was made of 514 replies.

Findings.—(1) "Though many occupations are included in the lists, . . . the great majority of persons are engaged in only a few major occupations in the mountain region; and if what people do is any measure of what to teach, then most of the applications can be made in terms of a few principal occupations."

2. ". . . farming, homemaking, and health, industrial, and mechanical problems peculiar to the region are the most essential activities for the territory. . . ."

UNIT V

Problem.—To determine the scientific interests of children living in the mountainous sections of the region, from their questions about scientific topics.

Method.—A questionnaire which began with an explanation emphasizing useful materials and which provided two model statements, requested the pupils to list the topics they thought most useful to them. From all the schools, a total of 502 pupils responded, listing 5197 items which represented 186 topics. An analysis was made of the responses received from the pupils of 2 of the schools to determine the extent to which their statements had been influenced by the textbooks of general science which they had studied.

Findings.—(1) "The greatest interest seemed to be in those things dealing with securing a living in the region."

[1] The pupils in this and the following units represented 227 counties in the mountainous sections of the eight Southern Appalachian states.

2. "The pupils were considerably interested by what they had already studied in eighth-grade science classes."

3. "Many questions asked dealt with the theoretical side of things rather than the practical."

Method.—The pupils were asked to list the papers and magazines received and read in their homes. The different publications, which numbered 296, were classified in 10 groups. Twelve copies were analyzed from each of these groups having high frequencies of pupil, listing, and 6 "for each of the ones with less frequency." In all, 1024 copies were analyzed. "Of these 48 were young people's magazines, 48 were educational in nature; 186 were devoted to farm life; 72 were revoted to current events; 108 dealt with the home and interests of women; 21 were news publications local in character; 471 were news publications general in character. The number of square inches of each article was measured regardless of size of type. The measured materials were then classified under the same headings as those used in analyzing the textbooks and classifying the science interests of pupils." (Units II and V.)

Findings.—(1) "If the materials in newspapers and magazines denote the interests of their readers, people are mostly interested in their immediate rather than in their remote surroundings."

UNIT VII

Problem.—To determine the activities in which pupils and their parents engage and to determine which of these are appropriate for a course of general science.

Method.—In a questionnaire the pupils were asked to state the activities in which their fathers, their mothers, and they themselves engaged. This questionnaire was presented orally by the investigator to 72 pupils. A prize was offered to the pupil submitting the best list of "activity situations." A total of 471 activities was submitted. The lists were checked and the activity situations were classified. Another questionnaire, which included the activity situations suggested by this group, was prepared and submitted to the pupils in 12 high schools, who were asked to check those activities in which they, their mothers, and their fathers engaged. The "activity situations list" was personally presented to 50 teachers of science with the request that they check those items which they thought should not be included in an eighth-grade course of study. The lists were returned by 18 of these teachers. A comparison in "per cent of consideration given" each topic was then made of the results of these studies of activity situations and the results of the analysis of reading interests.

Findings.—". . . persons in the region devote most of their efforts to farming, homemaking, securing and caring for foods, and preservation of health. Other activities are complementary to these."

TABLE I.—*A Comparison of the Average Emphasis on Various Subject-Matter Units, as Indicated by the Content of Eight Textbooks of General Science, with the Average Emphasis as Revealed by the Reading Interests, Science Interests, and Activity Situations of Pupils in Schools of the Southern Appalachian Region.*

Units	*"Percentages of Consideration" Given Each Topic*	
	Textbook Analysis	*Average for the Other Three Analyses*
Farming	5.3	24.8
Home in general	4.5	16.9
Health	10.6	13,3
Food and diet	7.2	9.8
Mechanics	13.4	6.3
Animals	1.7	3.7
Recreation	5.3	3.7
Fire protection	1.6	3.6
Life in general	3.3	3.6
Plants	3.5	3.1
Water supply	4.5	2.2
Electricity	5.4	2.0
Weather knowledge	6.4	2.0
Heating the home	7.5	1.7
Lighting homes and buildings	5.5	1.7
Heavenly bodies	8.4	1.5
Ventilating buildings	4.2	1.7

Editorials and Educational News

MEETING OF ASSOCIATION OF SCIENCE TEACHERS OF THE MIDDLE STATES

The seventeenth annual meeting of the Association of Science Teachers of the Middle States was called to order by the President, Merwin M. Peake, in the Music Auditorium of the Chalfonte, Atlantic City, on Saturday, November 27, 1937, at nine o'clock.

The program was intended to show what science teaching is doing at various levels of instruction, both in this country and abroad, largely from the viewpoint of general education (thus connecting with the program of the preceding year). On Friday afternoon and on Saturday there were displays of science instructional materials explained and discussed by teachers and students in charge. These displays proved interesting to the considerable number of visitors who examined them. The program was as follows:

Friday, November 26, 4:30 P. M. to 6:30 P. M.
Display of science instructional materials now in daily use in various schools in the Middle States area, grades 1 to 14, under direction of Lois Hutchins, Weequahic High School, Newark, N. J.

Saturday, November 27.

Discussion Topic.

What is being done in classrooms to develop a science education program suitable for the general education of the pupils?

Demonstration lecture using materials on display to illustrate the manner in which day by day science instruction may function in the general education of the pupil.
Warren W. McSpadden, Teachers College, Columbia University.

Discussion from invited leaders.

A Viewpoint of Classroom Teachers.
Dorothy Wheatley, Science Consultant, East Orange Public Schools.

A Viewpoint of a Technical Student.
John W. Brown, Student, Guggenheim College of Aeronautical Engineering.

A Viewpoint of a General Education Student.
Hildegarde Hartig, Student, New College, Columbia University.

A Viewpoint of a Classroom Curriculum Experimenter.
Lester R. Williard, teacher, experimenter, Thomas Jefferson High School, Elizabeth, N. J.

Intermission to Inspect and Handle Science Instructional Materials on Display.

A Report on a First-Hand Study of Classroom Activities in France and Russia.
Dr. Alexander Efron, John Adams High School, Ozone Park, N. Y.

Persistent Life Problems as a Basis for Science Education.
Philip Powers, New College, Canton, North Carolina.

A Report on Teaching Science by Radio to 22,000 Pupils.
Harry A. Carpenter, Science Specialist, Public Schools, Rochester, N. Y.

Business Meeting.

Discussion.

Luncheon.—Gold Room, The Chalfonte, 1:00 P. M.

Address.—Science Education as Seen Through the Eyes of an English Instructor.
J. A. Lauwerys, Lecturer and Tutor in charge of methods of physical science, University of London, Institute of Education.

Mr. McSpadden demonstrated with materials on display how simple apparatus can be made to serve a variety of uses. His concern was mainly with the first six years but it might easily be extended to the junior high school. In several mimeographed lists Mr. McSpadden suggested how a body of useful equipment may be built up, some at little expense, some at no expense, to "form a science corner or laboratory within the classroom." Children's toys are quite a valuable source. Miss Wheatley followed with demonstrations of work done by children in the form of notebooks, drawings, compositions, sculpturing, scrapbooks, etc.

Mr. John Brown brought the point of view of a student from a technical college, wishing for closer coordination between his learning and his living. Miss Hartig, whose experiences at New College were in-

teresting foundation for her remarks, contrasted her viewpoint with that of the preceding speaker.

Miss Hartig stated that in the preparation for work in education in New College, emphasis is placed upon the individual and the development of a curriculum directed towards his needs. Opportunity is provided for self-directed activity and independent study. The student's real curriculum is recognized to be the sum total of all his experiences, including many which take place outside the school.

The work in natural science at New College, in classroom and outside the classroom, is directed toward:

1. Awakening in students a keen awareness and importance of science technology and the scientific method.
2. Developing an intelligent understanding and thorough articulateness concerning these principles and generalizations of science which are functional in the habits of thought and action of liberally educated members of society.
3. Providing the student with knowledge and skills needed in teaching science.

In the classroom of a newly developed biology course, offered for the first time this year at New College, one finds that there is very little presented in the way of organized lectures, which many colleges seem to consider of essential importance to the students.

All of the instruction centers around helping the students solve some particular problem which is individually interesting to him. There is no prescribed body of subject matter that must be covered in any given period of time and students are free to make use of the laboratory facilities provided at any time during the week. The class hours which are definitely set, are used mainly for discussion of problems which have arisen during the course of the week's work and for advice and guidance which will be useful in the solution of these problems.

If problem solving is to be considered one of the techniques essential to intelligent participation in modern life, it seems that there can be no course of study more valuable than one which gives the learner an opportunity to learn problem solving by working out his own individual problems.

From a student's viewpoint this working out of individual problems requires the opportunity, time and equipment for individual work as well as the wise conselling of experienced adults. As a student my plea to all you who are attempting to improve science instruction is to recognize us as individuals and not nebulous aggregates of questionable protoplasm and to provide individual experience which will aid us as individuals in making satisfactory and satisfying adjustment to our environment and to our fellow beings. Would not both teachers and students function more intelligently if they could only work cooperatively in promoting the general welfare through the recognition and solution of problems real to us as individuals and valuable to us as interdependent members of sociey?

Mr. Williard's demonstrations in elementary physics for non-college pupils in high school probably stirred a responsive chord in those instructors who are asked to deal more and more with certain adolescents, largely unknown in the public secondary school a few years ago, now in high school in increasing numbers. Mr. Williard demonstrated simplifications of Archimedes' Principle with applications to experiences of boys and girls. "These experiences I present as attempts on my part to explain the pupil's environment, not in terms of abstruse technical accuracy, but in such familiar and homely phrase and proof as are compatible with his limited ability and mode of life." His mimeographed sheets of a variety of simplified experiments were available to members and visitors.

After a short period for examining the materials on display the reports turned to foreign countries. Dr. Alexander Efron reported on science classroom activities in France and Russia based on a seven-month resident study made by the author.

"In spite of political upheavals and a

series of administrative changes, French secondary education remains today among the most rigidly fixed and traditionally stable systems on the continent."

Dr. Efron* traced the aims, selective character, and curriculum of the secondary school (lycee and collège) in its seven year program. In more detail he described the logical expository presentation of physics and chemistry. He described methods of teacher training in France with its insistence on subject matter but meagre professional preparation.

"Present day Soviet education reflects Russia's new political social and economic order." Seven and ten year secondary schools follow the primary level, and lead to the university level. Both "complex plan" and Dalton plan have disappeared to be followed by "stable school programs, stable and standard textbooks, formal tests and examinations." . . . The Soviet secondary school now aims very definitely at a general education, while retaining its polytechnical aspect as an instrument for changing the old social order."

Both chemistry and physics are required subjects with considerable emphasis placed on laboratory work, excursions in industrial plants and museums. As in France, the subject matter is approximately equivalent to our first year liberal arts courses. Training of teachers in service is a pressing problem in Russia. Combined with the course of study in science is the "use of materials of Socialist Reconstruction discussion of chemical warfare and self-defense, and the study of Five-Year Plans."

Mr. Powers† spoke on persistent life problems in science education.

New College Community is a branch of New College of Teachers College, Columbia University, devoted to training of teachers on an undergraduate level. "The chief purpose of New College Community is to provide an experience in intimate group living in a rural environment, and at the same time abundant opportunities for instruction in the natural sciences are available."

Mr. Powers described the equipment of the 80-acre farm and explained that "the problems of existence are faced by the staff and students as a group." "Instruction in the natural sciences enters chiefly into the problems relating to the control of the natural environment and the achievement and maintenance of good health." The speaker stated a number of the units of instruction, major objectives, and described in some detail the building and up-keep of the hydroelectric plant. He discussed the activities associated with the learning of principles and at attempt at testing when a principle has been learned. The relation of the New College Community to the larger community becomes a vital part of the program and presents opportunities for work in the social sciences as well as in geology, biology, and physics.

"There are certainly many difficulties associated with carrying out a teaching technique of this type; but we believe it offers a vital basis for giving instruction which adds to the interest of the students and enables them to learn more effectively."

Mr. Carpenter traced the history of the use of radio in Rochester schools, beginning as an emergency in the seventh year organization and continuing because of demonstrated value. He cited some of the problems and methods and explained the relationship of the radio lessons to the classroom activities. Mr. Carpenter read some of the fan mail showing the reactions of his listeners. These letters indicate "interest and thoughtfulness." Some are moved to break forth in rhyme. Attention was called to "the importance of the listening parents" who "for the first time may truly participate in the educational experiences of their children." Another value of the radio broadcasting is to the teacher in service, who becomes familiar with the methods and objectives, and who may be stimulated to further study.

* Editor's note.—Mr. Efron's paper was published in the March issue of this journal.

† Editor's note.—The paper by Mr. Powers is published in this issue.

During the business meeting the minutes of the previous meeting as published in SCIENCE EDUCATION in April, 1937 (reprints available to members), were approved as published.

The treasurer's report was read and ordered spread on the minutes.

TREASURER'S REPORT FOR NOVEMBER 27, 1937

Receipts

Balance on hand, November 27, 1936	$129.02
Interest	3.58
Dues received, 11/28/36 to 11/24/37	77.00
Interest, 1937	2.76
	$212.36

Disbursements

Lunches	$ 3.00
Expense accounts	18.03
Stationery	7.25
Reprints	6.22
Postage	8.71
Clerical service	1.00
	$ 44.21
Balance on hand, November 26, 1937	168.15
	$212.36

The nominating committee, consisting of W. L. Eikenberry, Sister Sylvia Morgan, Robert W. Kunzig, chairman, reported its slate through its chairman. As no other persons were nominated from the floor, a motion duly made and seconded was passed to have the secretary cast the ballot for the nominees presented by the committe. The following officers and members of the Executive Council were declared elected for 1937–38.

President, Mr. Robert N. Hilkert, The Hill School, Pottstown, Pa.
Vice-President, Dr. Wm. B. Meldrum, Haverford College, Haverford, Pa.
Secretary-Treasurer, Miss Dena D. Ungemach, Overbrook H. S., Philadelphia, Pa.
Council, Merwin M. Peake, Lafayette Jr. H. S., Elizabeth, N. J.
Professor E. C. Bewkes, Colgate Univ., Hamilton, N. Y.
Rev. Hubert Vecchierello, c/o Dr. J. P. Nickol, St. Bonaventure College, St. Bonaventure, N. Y.
Dr. Robert W. McLachlan, State Teachers College, Montclair, N. J.
Mrs. Pauline McDowell Atkins, Supervisor of Science, Elizabeth, N. J.

Owing to a regrettable delay in delivery of Mr. Earl Glenn's telegram requesting a vote on affiliation of the A. A. S. T. with the American Association of Science Teachers, this matter did not come up as an item of business. At previous meetings the consensus of opinion had been favorable to such anticipated action. Mr. Glenn has been the reappointed delegate of this association to the A. A. A. S. Committee on the Place of Science in Education from the time of its inception. Members may join the national association by sending one dollar to Mr. Homer W. Le Sourd, Treasurer, Milton Academy, Milton, Mass.

The luncheon was unusually well attended, being addressed by Mr. J. A. Lauwerys* in a bright and witty manner on Reflections on Science Teaching in the United States.

By way of introduction, Mr. Lauwerys described the triple system of education in England, based on caste and classes. In more detail he described the scholarship system, curriculum and methods and examination ("school certificate" system).

This excellent paper presented in an inimitable way concluded with suggestions about the responsibilities of science teachers in a democracy. "It (the education of children) is also an agency by which the community transforms its modes of living, of thinking and of feeling." For this there are necessary knowledge, clear and rational thinking and ideals of social conduct. Mr. Lauwerys finds in the United States ". . . far more concern with the idea of democracy, far more realization of the fact that it is not merely a form of government but a way of living together and that it is an ideal not yet completely accomplished, and which will require much effort and many changes."

The annual meeting adjourned at 4 o'clock.

Respectfully submitted,
DENA D. UNGEMACH,
Secretary-Treasurer

* Editor's note. Mr. Lauwerys' paper is published in the March and April issue of this journal.

REGARDING A STUDY OF THE SCIENCES FOR GENERAL COLLEGE EDUCATION

During recent years studies have been made of the contents, methods, and results of certain sciences used as part of college education. These studies, which were limited to special science subjects, made it clear that there is needed a comprehensive investigation which shall include all the major sciences used for general education.

During the meetings of the A.A.A.S. at Indianapolis, December 27, 1937, to January 1, 1938, the Executive Committee and Council passed the following resolution: "The Council voted to direct its standing Committee on the Place of Science in Education to represent the Association in the organization of plans for the evaluation and improvement of the teaching of science in colleges."

A Committee, that is representative of the sciences now offered in the colleges as a part of general education, is to be organized. The individual members will be selected from among those college teachers who are known for their scientific achievements and for their interest in improving teaching. Tentatively, the Committee is known as the Committee on Improvement of Science in General Education.

The work suggested to the Committee on Improvement of Science in General Education is roughly outlined in the following sections of this memorandum. It is understood that this Committee, when organized, shall further define its purposes and procedures, and shall be responsible for the supervision and conduct of its work. Constructive suggestions are welcomed from any source.

PROPOSED FUNCTIONS OF THE COMMITTEE ON IMPROVEMENT OF SCIENCE IN GENERAL EDUCATION

General: To initiate, encourage, guide, and support studies designed to explore, evaluate, and improve the teaching of the sciences as a part of general education.

Specific: 1. To clarify and define the problems involved in teaching the sciences as a part of the program of general education.

2. To develop a more scientific attack upon problems of science teaching; that is, to promote experimentation; to collect evidence, to encourage the use of procedures justified on the basis of organized and evaluated evidence in contrast to opinions, untested assumptions, and uncritical acceptance of traditional practices.

3. To disseminate information about the Committee's work, and to secure constructive criticism by means of discussion groups in college and university centers, by participation in programs, and by such other means as may be found effective.

4. To obtain and to use financial support for such work in the sciences as gives promise of being effective in improving the teaching of science in general education.

5. To serve as a clearing house for coordinating the activities of the several agencies now working on parts of the whole problem, and now agencies which may be initiated for the improvement of science teaching.

Meetings of available members of the Committee on the Place of Science in Education were held in Indianapolis on December 30 and 31, 1937. A third meeting was held in Washington, D. C., February 20, 1938. Also, correspondence between committee members has helped to formulate this memorandum. The following statements as guides have been formulated:

1. The Committee on Improvement of Science in General Education should include outstanding scientists and college teachers who have a deep interest in general education, who have had successful experience with science at various levels, and who are able and willing to devote considerable though and effort to the project.

2. The Committee on the Place of Science in Education should undertake to learn who are regarded as probably useful members of the proposed new committee.

The Committee on Improvement of Science in General Education in its early stages should not be large, and may add to its own membership as it finds desirable, and as approved by the Executive Committee of the A.A.A.S.

3. It is proposed that the Committee on the Place of Science in Education shall attempt to secure funds to support the preliminary meetings of the Committee on Improvement of Science in General Education, to employ a worker to serve under guidance by the Committee, and to cover the cost of exploring the project in order to formulate a comprehensive statement of the problems which should be attacked.

4. It is expected that the Committee on Improvement of Science in General Education will prepare its plans, and will request additional adequate funds for conduct of its work over a sufficient period of time to provide fundamentally significant results. Any funds granted for the work of the Committee shall be disbursed by the Permanent Secretary of the A.A.A.S. on orders issued and signed by the proper officer of the Committee on Improvement of Science in General Education.

5. It is the intention that, at the beginning, two persons will be named from each of the subject divisions. As soon as funds are available for the initial work of the proposed committee, the Committee on Place of Science in Education will proceed to enlistment of the initial members of the proposed Committee on Improvement of Science in General Education. These members will be asked to hold a meeting for organization and planning. Part or all of the members of the Committee on Place of Science in Education will attend the first session of the first meeting of the Committee on Improvement of Science in General Education. Thereafter the new Committee will proceed according to its own plans.

BY THE COMMITTEE OF THE PLACE OF SCIENCE IN EDUCATION

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Abstracts

GENERAL

SMITH, IRVING W. "Object Groupings in the Great Falls High School." *The Clearing House* 12: 323–328; February, 1938.

Accepting Glenn Frank's dictum "No one can teach anybody else anything; the best we can do is to help others to learn for themselves," the Great Falls High School staff decided to rebuild their foundations of methods. Department heads have been discontinued and in their place there are a certain number of positions carrying the title of "coordinator." There are also no more supervisors but "consultants"—filled by persons showing alert leadership, friendly service and unusual skill. Believing objects and integration to be more fundamental than subjects, an attempt is being made to break down former subject-matter divisions. An attempt is being made to (1) Deliberately build up a better and more intimate acquaintance with the work of fellow-teachers; (2) Deliberately plan for and encourage actual exchange of teachers among classes, or classes among teachers; (3) Undertake group study by teachers in the several fields in order to achieve a greater degree of coordination within each field; (4) Elevation of school library to a position of real importance in serving the school as a whole; (5) Become really acquainted with the pupils; and, (6) Capitalize the individual differences among the teachers.

—C.M.P.

TYLER, RALPH W. "Defining and Measuring Objectives of Progressive Education." *Educational Research Bulletin* 15: 67–72; March 18, 1938.

Progress made in evaluating or appraising the programs of the thirty schools in connection with the Eight-Year Study is reported. The task of clarifying educational objectives is very important and difficult. Several exploratory procedures are being tried out to perfect more definite instruments of appraisal, especially for the less tangible outcomes. —C.M.P.

JACKSON, C. O. "Clean Sports—A New Angle." *Hygeia* 15: 987–989; November, 1937.

The author who is assistant professor of physical education, University of Illinois, discusses some of the common violations of accepted and socially approved principles of health which are found in athletic contests. He gives results of his state-wide survey of health and sanitary practices in high-school athletics the purpose of which was "to learn something specific about the care of the physical plant and the personal equipment of all students engaged in varsity athletics." —F.G.B.

HUTCHISON, ELIOT D. "Speeding Up Your Reading." *Hygeia* 15: 811–855; September, 1937.

Dr. Hutchinson who is professor of psychology at the University of Rochester describes modern psychologic techniques used in measuring efficiency of reading habits. He believes that "these modern methods will soon become prevalent as a means of working with vision as the most important factor in learning."

—F.G.B.

JUNIOR–SENIOR HIGH SCHOOL SCIENCE

HANCOCK, CYRIL H. "Great Falls' Inclusive Course in Science for Seniors." *The Clearing House* 12: 397–399; March, 1938.

This article describes the attempt being made in the Great Falls High School to develop a course in science for seniors that definitely breaks down the present artificial barriers between present science courses. The basic philosophy of the course is stated as follows: (1) The understanding of contemporary life; (2) The danger of over-specialization; (3) The understanding of principles; (4) The need for problem-solving; and (5) The importance of attitudes. "The course is concerned with those scientific principles that ramify most widely through the experiences of laymen and assist them in interpreting contemporary life or making adjustments to this complex, changing civilization. —C.M.P.

ZAPF, ROSALIND M. "Superstititons of Junior High School Pupils. Part I. Incidence and Relation to Emotional Maladjustment." *Journal of Educational Research* 31: 435–446; February, 1937.

Miss Zapf describes an extensive study in which she investigated superstitious beliefs of ninth-grade children ranging in age from 14 to 16 years who were enrolled in the Cleveland Intermediate School, Detroit, Michigan. The study was directed toward the following problems:

To what degree are children at this age level superstitious?

What relationship exists between belief in superstititons and emotional stability?

What relationship exists between the fears and worries expressed by children and their superstitious beliefs?

Are children generally consistent in their be-

liefs or does the superstitious child show belief in one group of superstitions at one time and another group at a later time?

The following tests were used in the study:

Maller and Lundees—Superstitions and Emotional Maladjustment.

Zapf—100-item Superstition Test.

Woodworth Mathews Personal Data Sheet.

The conclusions derived from this study may be summarized as follows:

The mean number of superstitions believed by children according to the Maller and Lundeen test was 9.21 and according to the Zapf test was 17.01.

The tests showed that the girls were more superstitious than the boys.

The tests indicated a slight positive relationship between beliefs in superstitions and emotional maladjustment.

There was a slight positive correlation between worries and the *true* scores of the Zapf test.

Children are not consistent in their superstitious beliefs. —F.G.B.

Floyd, Oliver R. "General Science as Preparation for the Study of Biology, Chemistry, and Physics." *Journal of Educational Research* 31: 272–277; December, 1937.

The author gives a brief review of the results of studies bearing on the claim that is advanced frequently, that the study of general science is a preparation for the study of biology, chemistry, and physics. He then presents the results of his own investigation which was carried on with pupils enrolled in science classes in the University of Minnesota High School during the years, 1928–1933. The offering in science in this school during these years were general science in ninth grade, biology in tenth grade, and physics and chemistry open to pupils in eleventh and twelfth grades.

The results of this investigation according to the author "indicate that the study of general science in the ninth grade in the University of Minnesota High School, cannot be justified on the grounds of its preparatory value for success in advanced science courses. This study has no bearing on the value of general science in other respects." —F.G.B.

McMullen, Harold G. "Laboratory Techniques Test." *School Science and Mathematics* 38: 274–276; March, 1938.

This test of laboratory techniques in chemistry is an interesting and laboratory contribution, not only because it focuses attention upon good laboratory practice but because it forces the pupil to consider the fundamental purposes behind each of the techniques. —F.D.C.

Webb, Charles S. "The Teaching of Advanced Science Using the Demonstration Method." *School Science and Mathematics* 38: 20–28; January, 1938.

A thought-provoking discussion of the new movement toward senior science for the pupil who does not plan to attend college, and the relation of senior science to the conventional courses in physics and chemistry. The article embodies also a good discussion of the text which have already appeared in response to the demands for instructional materials suitable for the new course for the senior high school. —F.D.C.

Warren, C. C. "The Segregation of Chemistry Students as to Their Needs and Abilities." *School Science and Mathematics* 38: 53–59; January, 1938.

This stimulating discussion is presented in two parts: first "a justification of segregating chemistry students according to their needs and abilities in our secondary schools," and second, a discussion of the methods employed in effecting these ends in the Hughes High School of Cincinnati, Ohio. An interesting feature of the discussion is the inclusion of fifty experiments of a practical nature, "developed and written in the past few years by the men in the Chemistry Department at Hughes." —F.D.C.

SCIENCE

Reichert, Philip. "How Medical Discoveries Are Made." *Hygeia* 15: 122–123; February, 1937.

The author states that while it is possible for laymen to make important medical discoveries by the use of simple home remedies and by what might be called hit-and-miss methods, he believes that such discoveries are extremely unlikely.

Medical discoveries are usually based on numbers of observations, experiments, tests, and reports. They involve definite formulae that make is possible to repeat the studies; application of the formulae to definitely diagnosed conditions; and finding out whether or not the condition is actually relieved by the treatment. In other words, they are made in terms of cause and effect relationships. They result from using the scientific method of work.

The author illustrates his discussion by the story of how digitalis became a heart remedy and how insulin was found to be successful in combating diabetes. —F.G.B.

Cramp, Arthur J. "Some Peculiar Patents, Traps and Contraptions for the Gullible." *Hygeia* 15: 238–241; March, 1937.

The author describes a number of products classed in the medical field that have been patented by the United States Patent Office and later found to be fraudulent and taken off of the market. Some of the products described are Perkins' metallic tractors which were said to remove pain; Myers' tapeworm trap; Pedal Ca-

lorificator, a footwarmer; a dimple machine that was described as "a device which serves either to produce dimples on a human body or to nurture and maintain dimples already existing;" Saches' oxydonor, a device that was supposed to furnish the body with extra oxygen; an electrical device to extract poisons from the human body; and a goiter cure necklace.

—F.G.B.

GORDON, SAMUEL M. AND DUFOUR, ELEANORE B. "Tooth Bleaching Quackery." *Hygeia* 15: 315–316; April, 1937.

For many generations pearly white teeth have been set up as a criterion of beauty. The desire for white teeth opened up a fertile field for the development of stain and tartar removers, many of which have been found injurious to teeth. Tests have shown that hydrochloric acid is a common ingredient of most of such preparations.

The authors discuss some products widely advertised to whiten teeth that have been exposed by the New York Academy of Dentistry and the Council on Dental Therapeutics and by the American Dental Association Bureau of Chemistry. The article closes with the statement that "there is no safe, quick way to clean the teeth with acids as a short cut." —F.G.B.

GORDON, SAMUEL F. AND DUFOUR, ELEANORE B. "Pyorrhea Quackery. *Hygeia* 15: 398–401; May, 1937.

This article discusses the careful and individual treatment of gum diseases commonly included under the term "pyorrhea" that is exercised by the dentist and the local and general hygiene during and after such treatment. In contrast to this attitude is that taken by "exploiters of 'patent medicines' which are 'guaranteed' to cure pyorrhea or by makers of dentifrices for which bleeding or sore gums is part of the sales talk. There is real danger in the use of these so-called 'pyorrhea' cures, for by the time the user has come to the conclusion that he is not being cured, the condition has reached a hopelessly advanced stage."

The essential facts regarding a few of the "cures" that have been reported by the Council on Dental Therapeutics and the American Dental Association Bureau of Chemistry are given in the article. —F.C.B.

TRAUB, EUGENE F. "Your Skin and the Summer Sun." *Hygeia* 15: 394–397; May, 1937.

Dr. Traub, professor of dermatology, University of Vermont College of Medicine, discusses skin disorders common in summer and how to treat the skin during summer months. He says that in the case of a few common skin diseases, such as acne, psoriasis, and certain varieties of eczema there should be improvement during the summer. He also says that most of the skin disorders that are peculiar to summer may be avoided by using proper care of the gastro-intestinal tract and caution in regard to sun exposure. Some of the common skin diseases of summer discussed in the article are "heat rash," sun burn, plant poisoning, and certain fungus diseases, such as ringworm. —F.G.B.

FISHBEIN, MORRIS. "The Truth About Candy." *Hygeia* 15: 1075–1077, 1150; December, 1937.

In this article, Dr. Morris Fishbein, editor of Hygeia, answers common questions about candy, such as the following: What is the place of candy in the diet? Should candy be eaten between meals? Is candy fatttening? Should children be allowed to have candy? —F.G.B.

ANONYMOUS. "River to Lift Itself Over a Mountain." *Popular Mechanics.* 69: 321–323, 157A–158A; March 1938.

Water from the Colorado River is to be pumped up the side of a mountain and allowed to run a generator as it runs down the other side. Part of the electrical power so produced is utilized to pump the water from the river at the beginning of this cycle. This apparent contradiction to the law of conservation of energy is of course due to the fact that the power station on the opposite side of the mountain is lower than the reservoir from which the water is pumped. The water is raised about 125 feet where it enters a tunnel through the mountain. It emerges from the other side and then drops to the powerhouse, making a total drop of over 800 feet. The project is essentially one of irrigation, the purpose being to divert enough water from the Colorado each year to be equivalent to covering some 300,000 acres to a depth of one foot. It is expected, however, to derive some 72,000,000 kilowatts of constant power, and 88,000,000 kilowatts of secondary power, in excess of that needed to pump the water. Details of the plan, expected to require five years for completion, are given. Excellent diagrams of typical turbine generator, and arrangement of pumping station, power station and tunnels are given.

—O. E. Underhill.

SCHNURMACHER, EMILE C. "Exploring World's Deepest Mystery." *Popular Mechanics Magazine* 69: 481–482, 158A–163A; April, 1938.

Further improvements on the Barton-Beebe bathysphere are described. This new device, called a diphrobenth (Greek for chariot of the bottom), is planned to go to mile-deep ocean bottoms, and be towed along the ocean floor by a surface craft. It is to rest on shock-absorbing wheels, with drums of gasoline attached to the suspending cable to give it buoyancy. The sphere, now in the blueprint stage, will be lighter in weight than the bathysphere by half, and have 35 cu. ft. of space as compared with 42 cu. ft. of the bathysphere. Other interesting details are given. —O. E. Underhill.

New Publications

VERRILL, A. HYATT. *Strange Reptiles and Their Stories.* Boston: L. C. Page and Company, 1937. 195 p. $2.50.

Another delightful book by the author of My Jungle Trails. This book debunks many of the strange and ridiculous beliefs, superstitions and popular fallacies connected with reptiles. The reason so many people regard all snakes with loathing and actual dread is partly because they do not know the facts and partly because they are unable to distinguish the harmless and beneficial ones from the venomous ones. The author has included numerous personal experiences with various reptiles, gained during more than forty years of explorations and scientific expeditions in tropical America. The largest snake is the Anaconda and the maximum length of any ever authentically measured is a little under twenty feet, all stories and claims of greater length notwithstanding. One of the most interesting reptiles described by Mr. Verrill is the Tiger Iguana of Campeche. There are many strange reptiles and some are dangerous, but our fears are all out of proportion to the actual dangers existing. High school boys will find this a story of exciting adventure, holding their interest as few authors can. —C.M.P.

VERRILL, A. HYATT. *My Jungle Trails.* Boston: L. C. Page and Company, 1937. 329 p. $3.50.

It has been said that A. Hyatt Verrill, author of My Jungle Trails, possesses a knowledge of Latin-American jungles probably unexcelled by that of any scientist-explorer in the United States. And as narrator of thrilling incidents he is a second Ditmars. My Jungle Trails is a narrative of adventures in the jungles of Central and South America and in the West Indies; of strange Indian tribes and their curious customs; and the fauna and flora of the jungle. This book holds one's interest comparably with that of a good adventure or mystery story. Out of the host of adventures told, those relating to the Shayshans, Indian Guardians of the lost gold mine of Tsingal; the living death; the story of army ants; and the story of Prince Charley and the Boorabee (Buccaneer) Indians are the best. A high school boy that would not have a real thrill in reading this book must have a real aversion to reading of any kind—his case would seem hopeless. —C.M.P.

SEARS, PAUL B. *Deserts on the March.* Norman, Oklahoma: University of Oklahoma Press, 1935. 231 p. $2.50.

Deserts on the March presents the drama of man's conflict with his own environment. In the first part of the book the author traces the westward advance of American civilization. As there came increases in population and the land became less fertile because of continued cultivation accompanied by unscientific cultivation, erosion and a complete lack of conservation measures, the pioneers pushed out to more inviting areas to the west. Thus was the pioneer fringe pushed all the way across the continent until no new, virgin soil remained for man's exploitation. Interested only in immediate results, heedless of the consequences of his farming methods, much of the once grass-covered regions of the west have become veritable deserts. In order to reap an immediate reward, grasslands that should have never been cultivated were plowed under to make way for cereal crops. Then a slight change in weather, probably no more serious or radical than changes in weather in former times, resulted in the dust storms of recent years—driving thousands from their homes, completely bankrupted—and leaving the region itself a desert. Man's unintelligent refusal to cooperate with nature has thus led to his undoing. Nature is kindly, if man cooperates—she can be brutal if man totally disregards her warnings. Deserts, and floods too, will continue on the march unless man has really learned the recent expensive lessons nature has been teaching him. Thus Dr. Sears joins Stuart Chase in warning Americans of the present urgent need for an intelligent plan for soil economy and conservation. —C.M.P.

BAKER, ROBERT H. *Introducing the Constellations.* New York: The Viking Press, 1937. 205 p. $2.50.

This book is a companion volume to When the Stars Come Out, and to the reviewer it seems to be the better volume of the two. The author, Professor of Astronomy at the University of Illinois, may be ranked as one of our best writers of popular astronomy. His style is interesting, clear, readable, sometimes poetic. The book is recommended to anyone who is beginning his reading in astronomy, and to high school and elementary science teachers.

The fourteen chapters trace the history of astronomy from the lore of the sky and the constellations as observed by the ancients, down to the powerful lenses of today as they reach out into the vastness of space. There are 34 entrancing photographs on sky-blue background and also 19 charts. —C.M.P.

WEST, JOE YOUNG. *A Technique for Appraising Certain Observable Behavior of Children*

in Science in Elementary Schools. New York: Columbia University, Bureau of Publications, 1937. 118 p. $1.60.

The purposes of this study are listed as: (1) to investigate briefly methods of appraisal which have been used in elementary school work; (2) to select from these the method most appropriate for appraising observable behavior in science in elementary schools; (3) to study teaching practices in certain available school situations; (4) to adapt the selected technique of these schools; (5) to secure data through the use of such an instrument of research; and (6) to state the implications of the results of such a study. The technique employed was the observation technique—a number of consecutive daily observations of a group for limited periods of time. Observations were made in science classes in grades three and five in one school and in grade six in a second school. Observation codes were developed for each class. Among the types of behavior observed; (Code 1) (1) Inquiry; (2) Critical-mindedness; (3) Open-mindedness; (4) Generalizing; (5) Scientific problem attack; (6) Recognition of achievements of thinking; (7) Recognition of interpretations of natural phenomena; and (8) Cause and effect relationships; (Code 2) (1) Responsibility; (2) Voluntary activities; (3) Initiative; (4) Application of experiences; (5) Self-appraisal; (6) Resourcefulness; (7) Skills; (8) Special abilities; (9) Work habits; (Code 3) (1) Curiosity concerning natural objects; (2) Recognition of beauty and harmony in nature; (3) Recognition of the value of natural products; (4) Recognition of the relationship between habit and structures; (5) Logical expression of facts; (6) Response to motivation; and (7) Reverence for the creator; (Code 4) (1) Searching for information; (2) Humane treatment of animals; (3) Conservation of plant and animal life and natural resources; (4) Recognition of common forms of plant and animal life; (5) Observation of natural life and phenomena; (6) Accuracy in reading; Pupil responses to questions; and (7) Correlation with other subjects.

It seems to the reviewer that the technique developed in this study offers great possibilities for wide adaptation and as such should be listed among the better theses of recent years. We are in great need of more researches of this type. It is a direct method of controlled observation that provides teachers, supervisors, other administrators and curriculum workers with a direct method of making appraisals of classroom behavior of children in science.

—C.M.P.

HARPSTER, C. E. *Supplementary Studies in Nature Science.* Books I and II. Bloomington, Illinois: McKnight and McKnight, 1937. Book I, 111 p., 48c; Book II, 112 p., 48c.

These are workbooks for use in the junior high school, with page references to the specific text, Patterson's *Science for Junior High School,* issued by the same publishers. In each book the units are arranged with special reference to the seasons. Provision for all types of work is made.

—L.M.S.

HARDING, T. SWANN. *The Popular Practice of Fraud.* New York: Longman's Green and Company, 1935. 376 p. $2.50.

The practice of fraud seems to be quite popular. The outside covering of the book lists: fraud in society, fraud in law, fraud in drugs, fraud in foods, fraud in history, fraud in science, fraud in industry, fraud in cosmetics, fraud in psychology, fraud in economics, and fraud in advertising. Almost all fields are covered except education—and there are evidences that even this field might be included—but maybe the author considered the profits derived in this field too small!

The author states that "there appears to be no limit whatever beyond which our good American manufacturers and business men will not go in order to defraud the consumer who comes innocently to market . . . this is not because our manufacturers as such are bound and determined to be rascals . . . but they live and do business in a society wherein mutual fraud is an acceptable basis of economic relationship." This explains our complacency and lack of righteous indignation when faced with the facts of ruthless, flagrant fraud and misrepresentation. It explains why Congress will not pass a decent pure food, drug and advertising bill. It is so much fun being fooled and serving as human guinea pigs—and who knows we ourselves may be fooling other people and using them as guinea pigs. If we object too strongly to our being their guinea pigs—they may object to being our guinea pigs.

This book represents a most sane approach to the problem of fraud in American products and advertising. It is not the crusading type as are some of the other books that have appeared in this field. The need of consumer education in our public schools is stressed. That would seem to be the only remedy promising hope of any radical changes for the better. —C.M.P.

LAMB, RUTH DE FOREST. *American Chamber of Horrors.* New York: Farrar and Rinehart, Inc., 1936. 418 p. $2.50.

The title of this book is based on an exhibit commonly called by that name which was on display in Washington during consideration of the pure foods and drugs act. This exhibit portrayed how the American people were being used as human guinea pigs or considered as morons by numerous food and drug manufacturers. The author is chief educational officer of the United States Food and Drug Administration, and her story is based on court records, official analyses, reports from government men in the field, transcripts of court testimony and data from scientific investigators.

This book is especially valuable because it

shows conclusively how the government is powerless to do anything about abuses which have grown up since the Pure Food and Drug Act of 1906, explains why the government has no control over beauty preparations, however harmful they may be, and reveals the rackets that flourish because there is no control of advertising. The present Food and Drugs Act is inadequate to protect us from impure, adulterated foods, fraudulent and dangerous medicines, substandard goods, poisonous spray residues on fruits rancid, filthy butter and so on. The only way out is a new Pure Food and Drugs act with teeth in it which will extend to the advertising of these materials. Moneyed interests and a politically-minded Congress have prevented the enactment of such a bill. This is a recommended book for the science teacher and the science library—high school or college.

—C.M.P.

KALLET, ARTHUR AND SCHLINK, F. J. *100,000,000 Guinea Pigs.* New York: Grosset and Dunlap, 1936. 312 p. $1.00.

This book on frauds in cosmetics, drugs and foods was the forerunner of the dozen or so books of a similar nature appearing in recent years. Its appearance was somewhat of a sensation, leading to great agitation for the passage of a new pure food and drugs act that would also cover cosmetics and radio, newspaper and magazine advertising. The pure food and drug bill initiated in the Senate at that time is still hanging fire—and many American people are still serving as human guinea pigs, ignorantly, blissfully taking the soothing syrups and poisons being meted out to them by unscrupulous manufacturers who sell their souls for a few cents profit. Lives are cheap when money is the stake. Maybe sometime a sleepy Congress will wake up to give the consumers a break. Until then not much can be done, except to educate the people of the dangers lurking in their foods and drugs. It is probably true that the dangers described in 100,000,000 Guinea Pigs and other similar books are somewhat exaggerated in some cases, however it is undoubtedly true that such cases are in the minority.

Chapter headings: (1) The great American Guinea Pig; (2) The grocer, the butcher, the baker; (3) A steady diet of arsenic and lead; (4) Prescriptions, magic and poison; (5) Danger in cosmetics; (6) Fake antiseptics; (7) The quack and the dead; (8) Three drugs and the law; (9) The medicine-makers; (10) Little white lies; (11) The failure of protection; (12) To make the best of a bad law; (13) When the consumer wakes up; and, (14) Your responsibilities.

This book was first published by the Vanguard Press. The book should be on every high school science shelf and made a required reading for every science teacher. —C.M.P.

KALLET, ARTHUR. *Counterfeit—Not Your Money, but What It Buys.* New York: The Vanguard Press, 1935. 96 p. $1.50.

This book reveals in pictures and text how the consumer is deceived when buying a great many different products and types of products. Not only are products named but there are numerous photographs that drive home the charges that fraud is very prevalent. Among the advertising and merchandising frauds exposed are those dealing with the sale of silks, blankets, milk, laxatives, clothing, gasoline, mouth washes, "vitamin foods," soap, headache "cures," and various food and drug preparations. "If you try to pass counterfeit money in exchange for counterfeit goods, you go to jail even if the value of the money equals the value of the goods—if someone gives you counterfeit goods in exchange for good money, he will not go to jail; instead he may buy a yacht or another motor car."

The table of contents lists: (1) Counterfeiters; (2) Tin by the Yard; (3) Those Center Slices; (4) Skimping; (5) "It's Guaranteed"; (6) Soap is Soap; (7) The Seven Deadly Stains; (8) The Gargle Gang; (9) Beans; (10) Charge All That the Traffic Will Bear; (11) Not So Crazy; (12) A Few That Made Good; (13) Milk Money; (14) It Didn't Hurt the Rats; (15) Poison; (16) That Hamburger; (17) Why not Stork Oil; (18) Science Proves It; (19) Ear Oil; (20) Perfection; (21) Clothes Counterfeit; (22) Eat It Like Candy; (23) Good Housekeeping Approves; (24) Analyze the Ads; (25) A Few Tests; and, (26) But It Doesn't Work.

—C.M.P.

PALMER, BISSELL B. *Paying Through the Teeth.* New York: The Vanguard Press, 1935. 297 p. $2.00.

This book is a critical analysis of dental nostrums. The tooth-paste, mouth-wash racket is one of the most extensive, most flagrant consumer frauds being perpetrated today.

The author, Dr. Palmer, is a former President of the New York Academy of Dentistry and also a former President of the American College of Dentists, and Editor of the New York Journal of Dentistry. With this background of experience, Dr. Palmer is qualified to speak authoritatively in this field. Like other commentators, he denounces the fads and nostrums of most of our mouth-washes and dentifrices, linked as they are with false claims and advertising. A list of accepted dentifrices are included, but the ones named are for the most part unfamiliar and ones not largely advertised.

This is the most complete book in the field and should serve as a useful reference guide for pupils and adults studying problems of consumer science. —C.M.P.

PHILLIPS, MARY CATHERINE. *Skin Deep.* Garden City: Garden City, New York: Garden City Publishing Company, 1937. 254 p. $1.00.

This book discusses cosmetics and beauty aids —the facts stated being based on researches of Consumers' Research. The beauty "racket" is a quarter of a billion dollar industry—where the initial costs are small and the margin of profits

large. Topics discussed include: (1) Face and talcum powders; (2) Cold cream; (3) Nail preparations and hand lotions; (4) Lipstick, rouge, and eyelash preparations; (5) Astringents; (6) Hair preparations; (7) Deodorants and depilatories; (8) Facial packs; (9) Sunburn preventives; (10) Reducing preparations; (11) Soap; (12) Advertising; (13) Diet; and, (14) Safeguarding health and beauty. Products discussed are named. An earlier edition was published by Vanguard Press. —C.M.P.

PALMER, RACHEL LYNN AND GREENBERG, SARAH K. *Facts and Frauds in Women's Hygiene.* New York: The Vanguard Press, 1936. 311 p. $2.00.

This is a medical guide against misleading claims and dangerous products commonly used by women. This book does for widely advertised articles of women's hygiene what *100,000,000 Guinea Pigs* did in the field of foods, drugs, and cosmetics. All the advertising ingenuity that the brain of high-pressure advertisement writers can conjure is brought to bear in this highly remunerative market. When one reads regarding the methods used, the absolutely false misrepresentations and the total disregard of fair prices one can well wonder just how civilized we are after all and whether or not Christianity is ever, even remotely, practiced in this field. Germany's and Italy's high-handed methods in world affairs have nothing on these nostrums quacks. It would seem that it is about time we were educating our high school youth to the dangers and obnoxious methods used.

—C.M.P.

MORELL, PETER. *Poisons, Potions, Profits.* New York: Knight Publishers, Inc., 1937. 292 p. $2.00.

The subtitle of this most interesting and revealing book is The Antidote to Radio Advertising. Like many of us Mr. Morell found that his enjoyment of many radio programs was either greatly impaired or completely ruined by the mass of false and misleading statements made by manufacturers concerning their products. Mr. Morell checked what appeared to be exaggerated radio blurbs against the actual properties of the products advertised, and was struck by the glaring discrepancies between the two. He decided to check up at such leading radio stations as NBC and CBS, by reading written transcripts of the "commercial plugs" broadcasted. To his surprise, no "commercials" were on record at any of these offices, despite the government's ruling to the contrary. With the aid of a dictaphone rigged up before a radio loud speaker, he recorded sufficient radio commercial plugs (false, exaggerated, misleading) to realize that a book on the subject would fill a vital need. *Poisons, Potions and Profits* makes an analysis of the evils inherent in radio, fearlessly indicting specific manufacturers, manufactured products and radio entertainers for transgressing public right. Analyses of compositions of various products are included as well as tables of actual costs of ingredients as compared with their stated selling prices. The Good Housekeeping Institute is severely criticised for approving many products that are falsely labeled and represented. Their seal of approval apparently means very little.

We are spending roughly a third of a billion dollars annually in advertising. Seventeen firms spent over a million dollars each in radio advertising in 1936, headed by Procter and Gamble with more than three million dollars.

The book is highly recommended to science teachers and pupils. —C.M.P.

BENNETT, H. *More for Your Money.* New York: Chemical Publishing Company, 1937. 251 p. $2.75.

More for Your Money has as its purpose the listing of information and tests whereby one may judge the quality of products that one buys. Products are not named but this guide tells you how to judge products for their true value and effectiveness. Standards of judging quality are set up. Such questions are considered as: Common faults in buying; label reading; food adulterants; cosmetic and drugs; soaps, cleaners and polishers; radios; silks; artificial fibers; furs; shoes; furniture; shirts and socks; automobiles; gasoline; life insurance; and so on.

Science teachers will find many useful hints in this book, if any part of their work is devoted to consumer science. It is a book that should find a useful place on every science bookshelf. The author is editor of the well known *Chemical Formulary* and *Practical Everyday Chemistry.* —C.M.P.

FOWLER, BERTRAM B. *Consumer Cooperations in America.* New York: The Vanguard Press, 1936. 305 p. $2.00.

The author believes that consumer cooperation is America's way out of its economic chaos. About two million Americans are now interested in consumer owned and operated retail, wholesale and manufacturing enterprises. The author believes there will be a rapid development of consumers cooperatives. Consumer cooperatives have reached their greatest development in Sweden where they have been most effective. The author traces the aims and accomplishments of cooperatives in this country. —C.M.P.

GARRIGUES, CHARLES H. *You're Paying for It.* New York: Funk and Wagnalls Company, 1936. 254 p. $2.00.

This book affords an excellent insight into graft and corruption. J. Edgar Hoover is quoted as saying "Politics is Public Enemy Number One" and this book corroborates that statement. The author is a well-known newspaper man and crusader against graft who admits his ardor cooled when "observing no diminution in the quantity or quality of graft, there came to be apparent the truth that graft is not a parasite

sapping the tree of democracy, but the very fruit of the tree itself." The author's thesis is that graft can never be severely curtailed as long as politicians have special privileges to confer or sell, and competitive business exists to receive or buy such privileges. The author defines graft, lists the grafters, the sources of graft and how the game of graft works and why it is practically impossible to punish those involved.

—C.M.P.

Carrel, Alexis *Man, the Unknown.* New York: Harper and Brother, 1935. 346 p. $3.50.

Man, the Unknown has probably had the greatest sale of any popular treatise of science. Such popularity indicates a book of unusual merit—a vitally interesting field, written in a clear readable style by some one who is an authority in the field. This book is just that. Dr. Carrel writes about the life of man—his body, mind and soul—information based upon positive data, made intelligible to every reader. The author is a scientist of international renown, a winner of the Nobel Prize, a research scientist at the Rockefeller Institute for Medical Research, co-discoverer of the Carrel-Dakin solution, and inventor with Lindbergh of the "mechanical heart."

In this book Dr. Carrel discusses what science has learned about man—his body, mind, health, soul, emotions, loves and hates, and disease. Many would not agree with the stress laid on mysticism and the possibilities of miraculous cures. There are just as many who applaud his daring, in stating the case as he sees it. This is a book that will have as much value in the next decade or so as it has now. —C.M.P.

Haggard, Howard W. *The Doctor in History.* New Haven: Yale University Press, 1935. 408 p. $3.75.

In the preface the author states he has written "a history of health for his children." The result is a very easy, very interesting and most unusual book. Enticing bits and incidents about plagues, poxes, superstitions and the doctors themselves, add immeasurably to making the book delightful reading. So as to get a good early start the author goes back to the days of the dinosaurs—there was disease before man appeared on earth as the fossils of dinosaurs clearly prove. And the Cro-magnons had their medicine men—the earliest doctors on record.

A major portion of the book is devoted to early medicine and medicine during the Middle Ages. Discussion relating to the last half century are relatively brief. This is an excellent supplementary book for high school biology classes. —C.M.P.

Morris, Robert T. *Fifty Years a Surgeon.* New York: E. P. Dutton and Company, 1935. 347 p. $3.50.

This is one of the finest autobiographies one is likely to meet in many a day. Someone has ranked it as one of the half dozen best books published in 1935 and the reviewer is more than inclined to agree with that opinion. In this drama of surgery, Dr. Morris reveals his professional life. It is the absorbing, fascinating adventures of a man whose personal and professional ideals have been the most exemplary. What a grand book for any high school boy or girl who is looking forward to a possible medical career to read. Would that all medical men (and teachers and other professional men, too!) had Dr. Morris' professional (and personal) ideals. It would soon be a different world! The story unfolded by Dr. Morris gives one a greater confidence in the abilities and integrity of the medical profession.

The book is much more than a story of one man's medical experiences—for the philosophy and wisdom of a man devoted to prolonging life and alleviating suffering might well be the guiding beliefs of everyone. What standards of ideals does it set up for other medical men to attain?

This book supplements *The Doctor in History*, by Haggard. It is a veritable medical history of the last fifty years. The reviewer regrets that Dr. Morris failed to discuss the socialization of medicine—it would have been interesting to have had his opinion. —C.M.P.

Haslund, Henning. *Tents in Mongolia.* New York: E. P. Dutton and Company, 1935. 366 p. $5.00.

The subtitle of this book is Adventures and Experiences Among the Nomads of Central Asia. It is a translation from the Swedish. The author was a member of the C. I. Krebs expedition into northern Mongolia, the object of which was "to found a farm for corn, horse and cattle raising, the farm to serve as a base for trading (furs) and an investigation of the district's minerals." And with such a purpose as a background-setting, the author weaves a narrative that is delightful reading to any person enjoying a good travel and adventure story. A great deal of scientific information is gleaned as one avidly rushes through the narrative. To those of us who will never enjoy the thrills of seeing the part of the earth described, the book affords a most enjoyable vicarious experience. One forgets that there is such a portion of the earth, and so great in extent until one reads such a book.

After a long trek through China a successful farming experiment is conducted at Bulgan Tal in outer Mongolia in a wonderfully fertile farming section of great future promise. But the long-arm of the Soviets reach out and the experiment is finally abandoned. Strange adventures as a fur-trader, with Chinese, Mongols and Russians, with a Shaman, as a prisoner in Shinkish, feats of endurance and escapes from death— make this a book that is dramatic.

—C.M.P.

HASLUND, HENNING. *Men and Gods in Mongolia.* New York: E. P. Dutton and Company, 1935. 358 p. $5.00.

This book relates further adventures of the author of *Tents in Mongolia,* reviewed above. Haslund hears of a mysterious Mongolian tribe, the Torguts, surviving in the Far West of Mongolia, and resolves to go in search of them. He is offered a job with the Sven Hedin expedition (1927) going part of the way to the Torgut country. On his way out he is sent to film the Devil Dancing at the Madari festival at one of the holiest Oriental monasteries. He makes friends with Yolros Lama, a reincarnation of Buddha, who predicts good fortune for Haslund in the west. The prophecy becomes known throughout the Mongolian world and attends Haslund wherever he goes. After a long trek across sun-scorched, wind-swept Black Gobi Desert the expedition reached the once-great but now abandoned city of Khara Khoto, a region once visited by Marco Polo. At last the expedition reached the Etsin-Gol river. Haslund finally reached the Torguts who received him as a friend. Living among them for a comparatively long time he made investigations relative to their origin, customs and habits. Thus a great people, previously linked to the world as a legendary name, are made real, human, great. If you enjoyed the movie "Lost Horizons," you'll equally enjoy reading *Men and Gods in Mongolia.* —C.M.P.

POPE, CLIFFORD. *Snakes Alive and How They Live.* New York: Viking Press, 1937. 238 p.

Many people fear snakes. Filled with misconceptions about snakes and their habits which they have never taken time to investigate, they go "jittering" through life frightening children and their uninformed friends with horrified admonitions. Most such fears are rooted in ignorance. Mr. Pope in this book has provided adequate information about snakes to dispel any beliefs not based on fact. In the straightforward manner of a person who likes and understands snakes he allows us to hunt snakes with him, to experience his pleasure with a new specimen, and to see the lives and habits of the snakes through his experienced and expert eyes. We find supposedly dry factual material relating to the size, age, growth, intelligence and locomotion of snakes vibrant with life and quite fascinating in its presentation.

The relationship of the size of snakes to their distribution, to their ability to conceal and protect themselves and to their relative usefulness in agricultural economy; the documented discussion of the age and rate of growth; the rather intimate description of the physiology of the snakes; the narration of snake habits; and the short but excellent chapter on the care of snakes as pets would make this a valuable book for most teachers of subjects involving natural science as well as for pupils in such courses.

The material on venoms and the adequate discussion of the treatment of snake bites meet a very crucial need for people in those geographical areas in which the more dangerous snakes range. The book closes with a standard key for the identification of snakes in the United States.

There are likely many omissions in the book and the thread of thought does not seem to be continuous. It is however a very readable and pleasant contribution to the literature of the field. —M. L. Robertson.

FORMAN, HARRISON. *Through Forbidden Tibet.* New York: Longmans, Green and Company, 1935. 275 p. $3.50.

This is an adventure story rivalling *Tents of Mongolia* or *Thirty Years in the Golden North.* It is the personal story of a young American who succeeded in going alone into Tibet where expeditions, backed by their governments, have failed. The book contains a great deal of new factual material about Tibet and its people. One of the chief reasons for Forman's successful penetration of the "Forbidden Land" was the fact that he came to be accepted by the Tibetans as one of their own, assumed Tibetan dress, and picked up enough of the language for practical use. Much space is devoted to the religious rites and the primitive mysticism with its strange magic. The description of one weird religious rite is entitled "I See the King of Hell."

Strange gods, strange beliefs, queer religious and marriage customs—that's Tibet. Inasmuch as the transmigration of the soul is the crux of their religious beliefs, the dead body must be immediately disintegrated so as to release the pent-up soul in order that it may enter another life. A few of the chapter headings: (1) The Boy God; (2) Gold– Literally Tons of It; (3) A Good Wife to Me—and to My Younger Brothers, Too; (4) Guess I'll Take All Four of You as Husbands!; (5) Bats?; (6) I See the King of Hell; and, (7) The Vultures' Banquet. —C.M.P.

MITCHELL, J. LESLIE. *The Conquest of the Maya.* New York: E. P. Dutton and Company, 1935. 279 p. $3.75.

The Mayas were the most remarkable people in pre-Columbian America. They were the only Indian race in possession of a civilization of high intellectual attainment, and the question of the origin of that civilization has been a matter of controversy for four hundred years. Arising mysteriously in the forests of Central America towards the end of the fifth century of the Christian era, it established a great cultural empire. A degenerate form of this civilization was still in existence when the Spaniards arrived to end the great racial adventure of the Maya.

Various theories as to the origin of the Mayas and the Indians have been advanced, but the author cites supporting evidence of migrations from northeast Asia through Alaska and thence

down the Pacific coast. The first half of the book reviews the theories of other Mayan explorers such as Gann and Thompson, as to the origin of the Mayas, the meaning of inscriptions, significance of architecture and sculpture, and causes for the final disappearance of the empire. The Mayas were seemingly strong in the sciences, especially astronomy and mathematics. The author does not agree with the theories often advanced for the decline of the Maya civilization, "There is no evidence to the effect that either the agricultural system failed, the land overtaken by seasons of singular wetness, depopulating epidemics raged, or that the Maya choked to death of a surfeit of their own imaginings." The author believes the decline was a slow, natural decay lasting two or three centuries. The chapters on the imagined life of the ancient Maya and the Spanish conquest resulting in the final downfall of a great civilization are the best in the book. This is one of the best books extant on Pre-Columbian America.

—C.M.P.

LEAHY, MICHAEL AND CRAIN, MAURICE. *The Land That Time Forgot.* New York: Funk and Wagnalls Company, 1937, 274 p. $3.00.

Not so many years ago the world was thrilled by a newspaper flash that a vast unexplored section of New Guinea contained a dense population hitherto unknown to the civilized world. This has proved to be the major geographical discovery of modern times. The interior of the island had been thought to be a mass of impenetrable mountain ranges which the map listed as "unexplored and probably uninhabited." Michael Leahy's unremitting search for gold in the forbidden interior of New Guinea led him to discover in the heart of New Guinea a fertile plateau valley of vast extent, inhabited by a quarter of a million stone-age savages.

Leahy's nightmare dash to file a gold claim, and fights with overwhelming numbers of stone-age cannibals who were merciless fighters and at the same time shrewd farmers and landscape gardeners are the highlights of an absorbing story of adventure. To anyone interested in stories of research and adventure in strange lands and stranger peoples the reviewer recommends this book as one of the very best.

The scientific world has given immediate recognition to Leahy's discoveries. The Royal Geographical Society awarded him the coveted Murchison grant and the highest mountain in the island, a peak of almost 15,000 feet has been named after its discoverer, and called Mount Leahy. —C.M.P.

BUCK, FRANK AND FRASER, FERRIN. *On Jungle Trails.* Yonkers: World Book Company, 1937. 280 p. $0.96.

On Jungle Trails is a series of stories about wild animals of Far Eastern jungles and the author's experience in capturing them alive. Frank Buck known the world over and better known as "Bring 'em Back Alive" Buck is the author of "Bring 'em Back Alive, Fang and Claw, and Wild Cargo." Many will recall some of his thrilling motion pictures, some of the very best that have been made of wild animal life in its native haunts.

Buck has supplied many of the animals found in American zoos—including 49 elephants, 60 tigers, 59 leopards, 40 kangaroos, about 100,000 birds, many snakes and monkeys. A list of these animals together with some information about Asiatic animals is found in the appendix.

Kindness toward animals is the keynote of Buck's attitude toward animals and toward peoples of other lands. In the foreword he says "in my whole career of dealing with wild creatures I have never willfully or unnecessarily harmed or injured a single one. I have only feelings of kindness for every creature that breathes on this earth."

The most interesting stories were those relating to elephants, leopard in a tree, Lal—a Loyal Boy, the Man-eating Tiger, and Leopard on the loose. This is a splendid story for junior and senior high school students. —C.M.P.

THOMPSON, MARGARET. *High Trails of Glacier National Park.* Caldwell, Idaho: The Caxton Printers, 1936. 167 p. $3.00.

This is not a travel guide but a charming book on the intimate beauties of Glacier National Park. America, the Beautiful, has no other spot more charming. There is no other spot like it in the world. It has a peculiar charm that ever lures one back. Mary Roberts Rinehart in *The Call of the Mountains* says, "I have traveled a great deal of Europe. The Alps never held this lure for me. Perhaps it is because these mountains are my own—in my own country. Cities call—I have heard them. But there is no voice in all the world so insistent as the wordless call of these mountains. Those who go once always hope to go back. The lure of the great free spaces is in their blood." And this description seems especially fitting for Glacier. Niagara, New England, Yellowstone, Colorado have charm but the lure to go back to Glacier is greatest. Miss Thompson says she agrees with the man who said: "I've always been leery of colored folders, especially those of the railroads, but here the roads are beaten at their own game, they are outclassed; and I defy any human agency to overvalue, pictorially or otherwise, the wonder with which I am yet full." If you have been to Glacier, you'll treasure this charming book; if you have not, you have a most pleasant vicarious travel experience awaiting you. There are numerous attractive photographs. —C.M.P.

THORNBOROUGH, LAURA. *The Great Smoky Mountains.* New York: Thomas Y. Crowell Company, 1937. 147 p. $2.00.

This is a friendly guide to the newest of America's national parks—The Great Smoky

Mountain National Park in western North Carolina and eastern Tennessee. This promises to become one of America's most famous parks. In 1936 before its official opening there were more than half a million visitors. It is easily accessible to the more dense center of population. The flora is unusually diverse, making it the botanist's paradise. It is estimated that there are more different kinds of plants here than in any similar area in the eastern United States. Nearly 800 species of fungi have been listed. Scenery and recreational activities will be the greater lure for most people. The book is written by one whose home is adjacent to the Great Smoky Mountains, and thus knows the people and region by first-hand experience through a long period of years. —C.M.P.

DOWD, MARY T. AND DENT, ALBERTA. *Elements of Foods and Nutrition.* New York: John Wiley and Sons, 1937. 279 p. $1.75.

This book presents up-to-date information about foods that ought to receive more attention from our school population. It is written for high school use and deserves use outside the regular home economics course. There are charts, diagrams, and half-tone illustrations. It covers the whole range; food classification, digestion, principles of nutrition, food combinations, preserved foods, and fallacies regarding foods. There are exercises and questions at each chapter end. —W.G.W.

WESTAWAY, F. W. *The Endless Quest: 3000 Years of Science.* New York: Hillman-Curl, Inc., 1936. 1035 p. $5.00.

This is an exceptionally fine critical history of science. At every point care is taken to point out the method of thinking by which the facts of science have been established and interpreted. Important ideas are developed in considerable detail and in a sufficiently elementary way that the reader may appreciate their significance even without background in the field of science involved. To each chapter is appended the most important sources used.

The organization is chronological, emphasizing leading personalities. However it is far more than a collection of biographies, an exceptional unity having been attained through constant comparisonbetween leading scientists of different periods, and through the tying together of the work of contemporaries. Only a list of its fifty-five chapters could give a true picture of the comprehensiveness of treatment. After an introductory discussion of the geography of the ancient world, a summary of early civilization and a chapter each to Babylonian astronomy and Egyptian mathematics, the next seven chapters deal with Greek philosophy. Three chapters deal with Roman science, "A Thousand Lean Years" and then through the 16th century. Nineteen chapters run the gamut from Copernicus to Faraday. Then follow "The Transition from the Older to the Newer Physics," "Some Problems of Modern Physics" and "Some Riddles of Modern Physics." The next eleven chapters deal with special fields; each a sort of "survey course" and short history combined. The last few chapters deal with certain philosophical aspects of the approach to knowledge through science. Those who talk glibly of cause and effect, hypotheses, scientific law and the like should read chapter 50, "Causation and Indeterminacy," and 51, "Hypotheses." Those who read Bertrand Russell, Eddington, Jeans and others of our modern mathematicians and mathematical physicists will enjoy chapter 52, "Mathematics and Mathematicians."

—O. E. Underhill.

JASTROW, JOSEPH (editor). *The Story of Human Error.* New York: D. Appleton-Century Company, 1936. 439 p. $3.50.

This should be on the "must" list for those science teachers who accept as part of their responsibility the task of attempting to aid their students in the appreciation and practice of scientific methods of thinking. Sixteen eminent scientists, each a specialist in a different field, write of the significant errors in the development of their particular subject. This is far more than mere negative history of science. While some of the chapters approach more nearly than others a sort of short history of the subject being treated, many of them are extremely penetrating analyses of the fundamental sources and types of error which have led men's thinking astray. The introduction by Dr. Jastrow is a high spot. A particularly interesting chapter to the reviewer was the one dealing with error in geography, as this subject, as a logical science, is not so often treated in popular or semi-popular manner. The attitude of Columbus, for example, with regard to the science of his day is interesting. The analysis of the meaning of "common sense" in the chapter dealing with error in physics could profitably be expanded to a whole book. The contributors in the fields discussed are: Astronomy—Harlan T. Stetson, Geology—Kirtley F. Mather, Geography—John Leighly, Physics—W. F. G. Swann (with a note on "Superstition in Mathematics," by Eric T. Bell), Chemistry—Charles A. Browne, Zoology —Howard M. Paishley, Physiology—Homer W. Smith, Neurophysiology—C. Judson Herrick, The Process of Civilization—James Harvey Robinson, Anthropology—Ralph Linton, Psychology—George Malcolm Stratton, Sociology—Harry Elmer Barnes, Medicine—Howard W. Haggard, Psychiatry—Abraham Myerson.

—O. E. Underhill.

DESCHIN, JACOB. *Making Pictures with the Miniature Camera.* New York: McGraw-Hill Book Company, 1937. 156 p.

This is one of the better books on miniature photography written by one amateur for others. those who read his column "Camera Angles" in The author, however, is hardly a beginner as

the *Scientific American* well know. Yet he manages to explain the essentials of miniature photography simply and lucidly and withal in a most pleasant and readable style.

The novice who has recently acquired a miniature is guided through the processes of "Taking the Picture," "Making the Negative," and "Making the Picture." The instructions are sufficiently detailed to be really helpful without complicating and confusing the business of getting good photographs.

Science teachers will be especially interested in the sections entitled: "An Animal," "Nature," "A Flower," "A Still Life."

The most attractive part of the book is the "Miniature Camera Gallery," consisting of 47 full-page photographs, excellently reproduced, which illustrate what can be done with various of the better-known miniature cameras. They only regret in the selection is limited to the more expensive instruments. The book might have had wider appeal, especially among students, if some of the moderate-priced, but adequate cameras had been included in the consideration.

—Morris Winokur.

FENTON, CARROLL LANE. *Life Long Ago.* New York. Reynal and Hitchcock, 1937. 280 p. $3.50.

An excellent book, telling the story of fossils for young readers. This book is packed with information, yet presented in an interesting style, which the reviewer believes would be easily read by children, although it is by no means to be read quickly and without accompanying thought and discussion. The story of plant and animal life as shown by fossils cannot, of course, be told in such detail without introducing many scientific terms, particularly names of plant and animal forms. However, great care has been taken to give the pronunciation of each new word used, and much information as to derivation is given, in order to make the new words as meaningful as possible. With regard to this vocabulary the author's position, as indicated in a brief chapter, "Easy or Hard," is one with which the reviewer is in accord. So often difficulty is confused with unfamiliarity. For example, ". . . Inoceramus (I-no-ser-a-mus) which is long and seems hard to pronounce. It is really no harder than "hippopotamus." . . . But inoceramus is commoner and easier to see, than the Hippopotamus. We find its big, long shells in hundreds of sand-banks, from New Jersey to western Texas." The reviewer has felt for some time that one influence of Thorndike's word list has been to make writers for children afraid to supply sufficient opportunity for children to grow in their use of words.

The book is profusely and well illustrated. The illustrations include the seven color plates of dinosaurs and the excellent geological timetable chart, prepared by Mr. James A. Allen under the direction of Dr. Barnum Brown, which have been made familiar to many teachers through the pamphlet issued by the Sinclair Refining Company.

Even though the book is written for young readers it should not be despised by adults. It should prove excellent reading for general science teachers who have not had opportunity to do special work in the field of geology. Anyone who wishes an introduction to study of fossils would go far before finding a better book to begin on. —O. E. Underhill.

TRELEASE, SAM F. AND YULE, EMMA S. *Preparation of Scientific and Technical Papers.* Baltimore: The Williams and Wilkins Company, 1936. 124 p. $1.50.

This is a very helpful manual written for students who are preparing articles on scientific or technical subjects. It might also be useful as a guide in theme and thesis writing. This is a third and enlarged edition. —W.G.W.

BUTLER, MARY C. *Happy Nature Adventurers.* Philadelphia: Dorance and Company, 1937. 113 p. $1.50.

We find here a number of short articles on nature adventure, among them: "The Quest for Nature Adventure," "Tall Pines," "Good Duck Days," "Blueberries," "The Silent Winged," "In Rocky Places," "In Wintry Weather," "My Chipmunk Family," "Treasure in Soggy Places." Adversely we regret to say the book is cheaply made and not at all in keeping with the value of the content matter. —W.G.W.

STOWELL, THORA AND BURGESS, THORNTON W. *The Book of Animal Life.* Boston: Little, Brown and Co., 1937. 315 p. $2.50.

Almost everyone is interested in animals, particularly with those that have something in common with man. This book deals exclusively with mammals. Man himself, a mammal, is very dependent upon other mammals. This book presents in thirty-nine interesting chapters accounts of the shapes, coats, coloring, minds, senses, weapons, homes, courtships, and voices of animals. It tells of the relations of animals with each other and with man. Besides many drawings, there are thirty-two full-page halftones. —W.G.W.

HAAS, ARTHUR. *The World of Atoms.* New York: D. Van Nostrand Company, Inc., 1937. 183 p. $3.00.

The World of Atoms has been translated from the original by George B. Welch. The material has been arranged in a series of twelve lectures which were given by the author at the Univeristy of Vienna in 1926. These lectures attempt to present some of the vast mysteries of atomic physics in the light of the lack of background in Physics of large masses of people. While it is not wholly a popular book yet it tends to present the material in this light. It is clear and very readable. It presents the material in a logical sequence in the development of the subject. The

author is one of the world's leading physicists and an authority in the field of atomic phenomena. Dr. Haas clearly traces the evidence which is secured from the phenomena found in the various branches of Physics. He starts with a discussion of matter and electricity and traces the development through atoms, light-quanta, spectra and energy levels, atomic structures, radio activity, atomic disintegrations and wave mechanics. In each of these he readily shows the influence upon our present-day concepts of the atom. The book is very readable and will serve as a good source book for those who do not intend to study the subject but still would like to have some knowledge of the material. For the serious student of atomic Physics it will be found to be a valuable book for him to use to orient himself in the maze of present-day material. —F. L. Hermon.

HIRST, A. W. *Electricity and Magnetism.* New York: Prentice-Hall, 1937. 388 p. $4.50.

During the last year a great number of new texts in the field of Electricity and Magnetism have been published. In this book one will find a sort of an average between those texts which are highly technical and those which are on the popular side of the subject. This text will be found to be excellent for the student who is just entering upon the serious study of the subject. Since a good deal of mathematics is usually necessary for a complete and accurate study of electricity and magnetism in this work we find that this subject has been treated with caution. We also find that while mathematics is not stressed, the author has not neglected to use that which is necessary and to develop it completely and with understanding. The book as a whole is very readable and is clearly worded. The diagrams are clear-cut and plain. The material is in the usual arrangement starting with the units and definitions, magnetism and ending with the principles of electric machines and electrostatics. At the end of each of the principal chapters there are numerous clear and thought provoking problems which are definitely for the purpose of emphasizing the principles contained within the chapter. This book is recommended as a source book, a textbook for the student who is beginning the serious study of the subject and as a text book for a second year study in Physics. —F. L. Hermon

PEARSON, KARL. *The Grammar of Science.* New York: E. P. Dutton and Company, 1938. 357 p. $1.00.

This is a reprint of one of the earliest attempts to popularize science. It is one popular science book that has stood the test of time and is now one of the well-known Everyman's Library series. Someone has said that Pearson in this book has defined better than anyone else the self-imposed limits of the scientific method. The book was first published in 1892. For sound thinking, lucid presentation, few books have ever equalled or excelled this one. —C.M.P.

FURNAS, C. C. *The Next Hundred Years.* New York: Reynal and Hitchcock, 1936. 434 p. $3.00.

The appropriate subtitle of this book is The Unfinished Business of Science, for it is primarily a discussion of the vast number of problems that science has yet to solve. As one reads this delightful, thought-provoking book—so many unsolved problems are listed that one sometimes wonders just what has science accomplished thus far. The author gives one the definite feeling that the unsolved problems outnumber the solved problems in numbers at least, if not in importance. Scientifically, man is still a savage—a long, hard road looms ahead before the mountain top Science Civilization is reached.

Each of the principal branches of science are taken up in turn and the shortcomings of present-day accomplishments are considered. Interrelations of the sciences are discussed, and the social consequences examined. This treatise is an excellent book for the embryo scientist who sometimes gets a feeling that all the big, worthwhile discoveries have been made in science and there remains very little to do. —C.M.P.

HASLETT, A. W. *Unsolved Problems of Science.* New York: The Macmillan Company, 1935. 217 p. $2.00.

"The ignorance of science is at least as diverse as its knowledge and in many respects more interesting . . . it is an obvious paradox that the more science knows the more there is to find out. The ignorance of one generation is the knowledge of the next. . . . But if asked what radio and light waves are—the scientist has again to take refuge in mathematics, which is only another way of admitting he has gone as far as he can. Sooner or later science must come up against the ultimate warning sign 'Thus far and no farther.'" With this philosophy as a background the author proceeds to discuss many unsolved problems in science, varying in scope from the atom to the problem of a seeming expanding universe. Among the more important problems discussed are: (1) The Creation of the Universe; (2) Are There Other Worlds Than Ours? (3) How Account for Similarity of Flora and Fauna of Widely Separated Areas? (4) What Caused the Ice Ages? (5) What Factors Control Weather? (6) What Is True About the Origin of Man? (7) Is Man a Machine? (8) The Beginnings of Civilization; and, (9) Science and Nature.

The author, a member of King's College, Cambridge, has written a provocative book on the many fascinating problems awaiting sufficient data for solution. —C.M.P.

SYMPOSIUM: *National Health Series.* New York: Funk and Wagnalls Company, 1937. $0.35 each.

This is a twenty volume series of vest-pocket health booklets prepared under the auspices of The National Health Council and written by leading health authorities. They lend themselves as excellent references for general science and biology classes. The authors and titles are:

Miner, Leroy M. S. *Why The Teeth.*
Smillie, W. G. *The Common Cold.*
Lewis, F. Park. *What You Should Know About Eyes.*
Laird, Donald A. *How To Sleep and Rest Better.*
Bigelow, Maurice A. *Adolescence.*
Galloway, T. W. *Love and Marriage.*
Wood, Francis Carter. *Cancer.*
Snow, William F. *Venereal Disease.*
Williams, Jesse Feiring. *Exercise and Health.*
Gillett, Lucy H. *Food for Health's Sake.*
Rowell, Grant. *Hear Better.*
Kleinschmidt, H. E. *Tuberculosis.*
De Normandie, R. L. *The Expectant Mother and Her Baby.*
Tobey, James A. *The Common Health.*
Scott, James Ralph. *Diabetes.*
Rice, Thurman B. *The Human Body.*
Hart, T. Stewart. *Taking Care of Your Heart.*
Pratt, George K. *Your Mind and You.*
Haggard, H. W. *Staying Young Beyond Your Years.*

—C.M.P.

Hoag, J. Barton. *Electron and Nuclear Physics.* New York. D. Van Nostrand Company, 1938. 502 p. $4.00.

Such advances have been made in technique and subject matter relating to the physical concepts of matter that the author's earlier volume, *Electron Physics,* not only needed revision but many additions. The present volume, written for the college student, covers the newer knowledge and presents the experimental evidence for those concepts which lie in the field of electron and nuclear physics. At each chapter end will be found experiments covering the chief concepts treated. There are helpful diagrams, and the book ends with a set of problems and useful tables. —W.G.W.

Achelis, Elisabeth. *The World Calendar.* New York: G. P. Putnam's Sons, 1937. 189 p. $2.00.

The material in this book consists of various addresses and papers of Miss Elisabeth Achelis, President of the World Calendar Association. These addresses and papers present something of the history of calendars and calendar-making and advances reasons why the proposed World Calendar—a twelve-month, equal-quarters plan should be adopted. There had been great hopes that an agreement would be reached by the League of Nations Calendar Reform Committee to push the plan for adoption on January 1, 1939, but at its last meeting the committee decided that such a reform would be inadvisable at this time. In the internim Miss Achelis and the World Calendar Association plan to carry on a program of education on the need of calendar revision. Really no valid reason exists why such a reform should not be speedily carried out—only inertia blocks the whole movement. This book admirably presents the case for calendar reform and Miss Achelis is to be most highly commended for her efforts in furthering such a needed reform. —C.M.P.

Thomson, J. Arthur. *The Outline of Science.* New York: G. P. Putnam's Sons, 1937. 1220 p. $3.95.

We find here in one volume what was brought out in 1922 in four separate volumes, priced at $18. The type is large; the illustrations (many in color) are fine, and the entire book is attractive. By far, the greater part of the material is of just as much scientific value today as when it was written. It touches upon astronomy, the invisible world of life, the human animal, natural history, biology, chemistry, story of the rocks, domesticated animals, science of health, and many other scientific topics. It does not have in its index such words as "radio," "photo-electric cell," "cosmic rays," "heavy water," and, of course, can give no accounts of the advances that have occurred in transportation and communication within the last sixteen years. But in spite of this lack, it is a valuable reference for many natural phenomena and life on the earth. —W.G.W.

Symposium: *Van Nostrand's Scientific Encyclopedia.* New York: D. Van Nostrand and Company, Inc., 1938. 1,234 p. $10.00.

Van Nostrand's Scientific Encyclopedia covers the basic sciences of chemistry, physics, mineralogy, geology, botany, astronomy, and mathematics: the applied sciences of navigation, aeronautics and medicine; and the three branches of engineering—civil, mechanical and electrical. Responsibility for each science rested largely with one scientist of note, giving that science a unity not otherwise attainable. The book is noteworthy both in the comprehensiveness of the scope of the terms covered and in the breadth of treatment in the individual article.

There are more than 1200 diagrams and illustrations. This encyclopedia will serve as a useful reference book on the library science shelf and to science teachers who desire an authoritative source of information near at hand. If it relates to science, you will most likely find it in this book. It is unquestionably the most complete book on science and its practical applications that has been published. —C.B.P.

Kelley, Truman L. *Essential Traits of Mental Life.* Cambridge: Harvard University Press, 1935. 145 p. $2.75.

A number of new methods of factor analysis have been developed since Spearman first presented his method of proportionality and the use of tetrad differences. Kelley in this latest book of his describes a new method for deriving Hotelling components. Variates are entered in the matrix for single tests, etc., and the matrix for analysis is comprised of variance and covariances. The process of eliminating covariance and thus obtaining uncorrelated components measured from axes at right angles con-

sists in the selection of the largest covariance in the matrix, then in the orthogonal transformation of the original variables by rotating through an angle θ, where θ is given by: Tan $2\theta = \frac{2p}{v_1 - v_2}$. The process is repeated with the maximum remaining covariance (as a multiple of its standard error) each in turn until all the covariances have been reduced close to zero. When completed the final variables constitute the n components. The components are then expressed in terms of the initial n variables, this being done by a simple substitution in a linear equation.

Because of the number of rotations necessary, especially with a large number of variables, the analysis is somewhat laborious, but work sheets and tables for rotating axes are attainable which will facilitate keeping track of the computations and provide desirable checks.

In addition to the description and illustration of this principal axes method of determining components, a comparison is made of it with Thurstone's center of gravity method.

Another informative chapter consists of discussions and criticisms of theories or methods of analysis of mental traits, such as those of Spearman, Tryon, and Thomson.

Two interesting chapters are devoted to the judgments of members of the Unitary Traits Committee and of others concerning essential mental, physical, and personality traits with consideration to the experimental identification of these traits. The book is indispensable to students of the analytical study of mental traits and personality, but others can well profit from its reading. —Palmer O. Johnson.

READ, JOHN. *Prelude to Chemistry.* New York: The Macmillan Company, 1937. 328 p. $5.00.

This is an outline of alchemy, its literature and relations. Too often alchemy is thought of as the pretended art of transmuting the so-called base metals into the noble metals, silver and gold. In a wider sense, alchemy was the chemistry of the Middle Ages and as Liebig says, "alchemy was never at any time anything different from chemistry." Alchemy in its broader sense was a science of vast implications, a system of research more or less closely related with other fields of thought. Read designates the period of alchemy as dating from the very earliest beginnings of chemistry, assigning either Egypt or more probably China as the home of alchemy. This gives alchemy a much greater period of existence (3500 B. C. to 1800 A. D.) than is sometimes assigned to the period preceding Lavoisier.

Prelude to Chemistry is probably the most authentic treatise on the alchemical period, being thoroughly documented by numerous references and excerpts from early and original sources. A series of interesting photographs based on illustrations found in writings of the alchemical period add much to the attractiveness of the book. —C.M.P.

SYMONDS, PERCIVAL M. *Education and the Psychology of Thinking.* New York: McGraw-Hill Book Company, 1936. 306 p. $2.50.

Psychological discussions about the nature of thinking are rare and even those few are quite meager. Hence this monograph fills a long-felt need. A major portion of the treatise is devoted to an analysis of various steps of the thought processes. Each of several chapters represents the analysis of a single aspect of thought. These aspects include: (1) Learning the meaning of a word, term or phrase; (2) Statement of relationships; (3) Formulating a question; (4) Classification; (5) Formulating a definition; (6) Providing illustrations or examples; (7) Selective recall; (8) Selection of basis of comparison; (9) Comparison on a single designated basis; (10) Evaluating recall; (11) Outlining; (12) Summarizing; (13) Generalizing; (14) Problem-solving; (15) Explanation; (16) Application; (17) Criticism; and, (18) Discussion. Following this is a chapter which attempts to tie together the various steps of the thinking process and to show how these steps are related. Later chapters are devoted to some of the imperfections in thinking, what education can do to improve thinking and how thinking may be tested. Teachers reading this book should be better able to conceive the task of the teacher in improving the powers of thought. Following the methods here suggested should result in pupils learning a method of meeting problem situations which will result in greatly increased resourcefulness, creativeness and capacity to find solutions of daily problems constantly met. —C.M.P.

BLACK, NEWTON HENRY AND DAVIS, HARVEY NATHANIEL. *Elementary Practical Physics.* New York: The Macmillan Company, 1938. 690 p. $2.00.

Caught by the sentence in the preface "Thus we have developed the subject, not in the sequence that to the adult seems logical, but rather from the psychological point of view . . ." the reviewer was moved to compare this edition with the Black and Davis of 1923, a revised edition of a text originally appearing about 1913, to see what changes in organization the psychological approach has brought about. Apparently the two turn out to be closely the same. About 90 per cent of the illustrations in the 1923 book are used in an identical form or slightly redrawn, in the 1938 edition, and are in almost the same order with almost identical captions. The changes in drawing are largely in the direction of changing cross-section line drawings to three dimensional perspective drawing. This is of course not necessarily a criticism of the text. The Black and Davis book has always ranked near the top, and in the reviewer's opinion still is one of the best of the high school physics

texts. It is interesting to consider, however, that an organization formulated about twenty-five years ago for a textbook in any subject, should be so little changed. It is of course expanded and brought up to date through the addition of much new material—from 544 pages in 1923 to 690 pages in 1938. We have heard much in the last ten years of new objectives for secondary school science, new ways of approaching the problems of teaching science, of new criteria for organizing curricula in science, supposedly formulated in the light of increasingly carefully thought out philosophies based on an increasing amount of research in the field of education. It seems that either the results of this experimentation and philosophizing have confirmed the thinking of these early textbook writers, or else the last ten or fifteen years of study of the problems of secondary school science teaching have had little effect on the organization of physics texts. —O. E. Underhill.

GRUENBERG, BENJAMIN AND UNZICKER, SAMUEL P. *Science in Our Lives.* Yonkers: World Book Company, 1938. 764 p. $1.76.

This latest arrival in the field of ninth grade general science texts is a well-written and attractive volume. Part one includes air, water, fire, and earth. Part two deals with man's control over nature. The organization differs a little from the average course and will be acceptable to, if not preferred, by many teachers. The book is very little illustrated. All pupils and many teachers will be glad of the summary at each chapter end. We can commend the authors for their list of questions and activities which cover and supplement each of the chapters. Each unit is introduced by appropriate question previews and an original picture suggestive of the content of the unit.

—W.G.W.

BENEDICT, RALPH C., KNOX, WARREN W. AND STONE, GEORGE K. *High School Biology.* New York: The Macmillan Company, 1938. 728 p. $2.00.

Three points of merit characterize this secondary biology: (1) Stress is laid upon the larger social values; (2) The text offers a real fusion of the sciences; and, (3) The organization presents a logical and pedagogical progression, and all principles are offered according to the rule—from the simple to the complex. This progression of units is indicated as follows:

From variety to unity—Units I and II.
To changing environment—Unit III.
To relationships—Units V and VI.
To reproduction—Units VII and VIII.
To human progress—Unit IX.

There are 560 illustrations, for the most part well done, and pertinent to the content being discussed. There are 506 review questions and 235 different activities. A bibliography of 95 books is listed at the end, and it seems to the reviewer that this selection might be improved upon. To the reviewer the main merits of the book would seem to be the excellence and usefulness of content material and the challenging way in which is it presented. This is a text that merits wide usage in the next few years. Every biology teacher desiring a new, challenging, up-to-date text should thoroughly examine High School Biology. —C.M.P.

CRAIG, EDNA AND STONE, GEORGE K. *Guide to High School Biology.* New York: The Macmillan Company, 1938. 146 p. $0.96.

This would seem to be an unusually good workbook for pupils in secondary biology. It can well be used with any text in biology. The exercises seem to be quite challenging and are unusually variable. Biology teachers using workbooks should give serious consideration to this guide. —C.M.P.

EVANS, WILLIAM LLOYD, DAY, JESSE ERWIN, AND GARRETT, ALFRED BENJAMIN. *An Elementary Course in Qualitative Analysis.* Boston: Ginn and Company, 1938. 231 p. $2.00.

This is a well set up manual. Each group for the cations gives preliminary tests, a block outline for method of analysis, and a diagrammatic flow sheet, review questions, supplementary questions, and laboratory record sheet. Following the section giving the techniques for identifying the various cations and ions (145 pages) is a short section (6 pages) giving a generalized scheme for analysis of an unknown. Following this is a section (49 pages) of the theory of qualitative analysis necessary for understanding and interpreting the procedures. An extensive appendix gives tables of reactions of cations, reactions of anions, solubilities, etc.

—O. E. Underhill.

PRATT, HENRY SHERRING. *A Course in Vertebrate Zoology.* Boston: Ginn and Company, 1938. 348 p. $2.20.

The aim of this text is to furnish a guide for the dissection of types of the most important groups of vertebrates. Each dissection is complete and not dependent upon others. The types for which detailed directions for dissection are given are as follows: Protovertebrates; amphioxus, Fishes; lamprey (cyclostomate), dogfish (elasmobranch), perch (teleost), Amphibians; necturus (caudate), frog (tailless), Reptile; turtle, Bird; pigeon, Mammals; cat, rabbit. An introduction of four pages discusses apparatus, anatomical terms, general techniques of dissecting and drawing, and gives books of reference and a classification of the Chordata phylum.

—O. E. Underhill.

BARKER, M. L. *Basic German for Science Students.* New York: Chemical Publishing Company, 1937. 186 p. $2.50.

The purpose of this book is to give the student a reading knowledge of basic scientific German.

The first part, consisting of 47 pages, contains grammar lessons and general passages. The second part, consisting of 79 pages, contains scientific passages. These passages vary in difficulty and cover a wide range of scientific subjects including chemistry, physics, zoology, botany, mathematics and medicine. The German text is printed on the left page of the book and the English translation is placed on the right page; this enables one to translate rapidly. The science passages are followed by a 28-page vocabulary and an appendix which contains typical scientific German passages from examinations given at the University of Edinburgh.

This book is recommended to anyone wishing to acquire a basic scientific German vocabulary.

—P. E. Hatfield.

HALL, CHARLES GILBERT. *Through by Rail.* New York: The Macmillan Company, 1938. 152 p. $1.32.

This is a social-studies reader intended primarily for use in the intermediate grades. Science teachers in these grades will also find it an excellent supplementary reader. It is a history of railroad transportation and holds the reader's attention constantly. It tells how George Stephenson made railroad trains go; George Westinghouse enabled trains to stop; and George Pullman made trains more pleasant to ride in. In the United States there are more than half of all the railroads in the world. "We have brought much to the railroads, too—the air brake, the telegraph, the telephone and the electric light. England brought them the greatest gift of all—the locomotive, which, after all, is the heart of the whole thing." The book contains many useful pictures. —C.M.P.